PHYSICS ABSTRACTS

SECTION A

of

SCIENCE ABSTRACTS

SECTION A, PHYSICS

SECTION B, ELECTRICAL ENGINEERING

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Mechanical testing
Non-destructive testing
Industrial radiography
Corrosion
Electrical and magnetic measurements and instruments
Electronic relays and counters
Automatic control mechanisms
Applied electrochemistry
Photocells
Thermionic tubes
Cathode-ray tubes
X-ray tubes
Induction accelerators
Cyclotrons
Amplifiers
Radio-wave propagation
Mechanical engineering
Heat engines
Illumination
Metallurgy

512

6676. Notes on the iterative processes. HARTREE, D. R. *Proc. Camb. Phil. Soc.*, **45** (*Pt* 2) 230–6 (1949).—The order of an iterative process for solving an equation is defined. It is shown that if a process of order $K + 1$ exists for an equation there is not a unique process of order K or less, and it is suggested that there may be a general class of equation for which processes of any order may be found. Where numerical work is in question, it is always possible to derive a second order process from a first order process. The extension of this to matrix equations and integral and differential equations is an urgent requirement. S. M.

512

6677. On the iterative solutions of algebraic equations. DOMB, C. *Proc. Camb. Phil. Soc.*, **45** (*Pt* 2) 237–40 (1949).—Methods of deriving iterative processes of any order for simple roots of algebraic equations. The simplest method described is based upon the Eulerian Algorithm. The method is applicable to some transcendental equations. S. M.

512 : 621.318.5

6678. Contact equations. SØRVIK, R. *Elektrotek. Tidsskr.*, **62**, 120–5 (*April* 5–15, 1949) *In Norwegian.*—Some examples of application of a relay and contact-circuit algebra [Abstr. 2091 B (1948)]. J. A. W. (R)

512.9 : 621.3

6679. Tensors and electricity. BOUTHILLON, L. *Bull. Soc. Franç. Elect.*, **9**, 212–34 (*May*, 1949) *In French.*—Simple algebraic and geometric properties of tensors are explained and the tensor theory of electrostatics and electromagnetism, is introduced. Explicit tensor, or vector formulae for all the important quantities are tabulated. The tensor form of Maxwell's equations is given. The aim of the paper is to demonstrate the use of the tensor calculus in electrical theory and the unification which results thereby. L. S. G. (R)

517.6

6680. The evaluation of integrals of the form $\int_{-\infty}^{\infty} f(x)e^{-x^2}dx$. GOODWIN, E. T. *Proc. Camb. Phil. Soc.*, **45** (*Pt* 2) 241–5 (1949).—The infinite sum given by the trapezoidal rule converges rapidly with quite a large interval in x and furnishes a good approximation to the integral. The method proposed by Turing [*Proc. Lond. Math. Soc.* (2) **48**, 180 (1943)] is used to estimate the error term. The error decreases very rapidly as the interval is decreased. Numerical examples are given. S. M.

517.93

6681. Second order differential equations of rank 2 in physics. KASNER, E. AND MITTLEMAN, D. *Proc. Nat. Acad. Sci., Wash.*, **35**, 338–42 (*June*, 1949).—Some properties of the equations are stated and some examples of physical phenomena, where they are important, are cited: (1) a charged particle in an electromagnetic field; if the motion is planar, the totality of trajectories forms a 3-parameter family; if the electrostatic field is derivable from a potential, these curves may be grouped into ∞^1 families of ∞^2 trajectories each; each family is a velocity family of rank 2; (2) motion in a rotating plane and the restricted problem of 3 bodies in the plane. L. S. G.

517.94 : 535.55

6682. Liebmann's formula: a complement to the optical determination of stresses. VILLENA, L. *An. Real. Soc. Esp. Fis. y Quim.*, **44**, 188–210 (*March–April*, 1948) *In Spanish.*—The usual difference approximations to the Laplace operator for a square mesh, and an irregular quadrilateral with perpendicular diagonals, are derived. A brief description is given of iterative and relaxation methods of solving the system of linear equations equivalent to a differential equation. The formula for a square mesh is attributed to Liebmann. S. M.

518.5

6683. Precise solution of partial differential equations by resistance networks. LIEBMANN, G. Letter in *Nature, Lond.*, **164**, 149–50 (*July* 23, 1949).—A re-examination of this method suggests that it may provide results more accurate than is generally supposed. E.g. an average accuracy of 1–2 parts in 10^4 was reached in solving Laplace's equation, $\nabla^2 f(r, z) = 0$, for given boundary values. The solution of the space-charge problem in a plane diode by a strongly convergent iteration process requires but 3 iterations to give a close solution. The method has been applied to "eigenvalue" problems. A. J. K.

518.5

6684. Progress in high-speed calculating machine design. WILKES, M. V. *Nature, Lond.*, **164**, 341–3 (*Aug.* 27, 1949).—An account of a conference at Cambridge in June, 1949. The electronic delay storage automatic calculator is smaller than ENIAC, but has greater storage capacity. The design of any such instrument is a compromise; a given operation can be carried out straightforwardly by a combination of the 4 basic rules, or by a special apparatus using a sub-routine, which is faster but more cumbersome. Many important details remain to be investigated, e.g. the need for checking units, the decision between scale of 2 and scale of 10, and the relative merits of electronic and relay machines. A number of machines is under construction in various parts of England and Europe. N. C.

518.5 : 621.318.572

6685. More differential analyzer applications. COOK, A. C. AND MAGINNISS, F. J. *Gen. Elect. Rev.*, **52**, 14–20 (*Aug.*, 1949).—Various problems in electrical and mechanical engineering are considered. A. O. S.

518.5 : 621.318.572

6686. Electro-mechanical and electronic calculating devices. DAVIS-BERRY, R. *Trans. S. Afr. Inst. Elect. Engrs*, **40**, 55–73 (*March*, 1949).—Deals mainly with punched-card machines. A. O. S. (R)

518.5 : 621.318.572

6687. The logical design of the Raytheon computor. Bloch, R. M., Campbell, R. V. D. and Ellis, M. *Math. Tables Aids Comput.*, **3**, 286–95 (*Oct.*, 1948).—Numbers are stored to a precision of 35 binary digits and with a fixed binary point. The standard precision of the basic arithmetic operation is 35 digits. 70 binary digits (double precision) can be stored and manipulated as pairs of standard numbers. The internal memory, which is briefly described electrically, has a planned capacity of 4 096 words (numbers or coded instructions), each comprising 35 binary digits, an algebraic sign and a check number. The pulse repetition rate is 4 Mc/s, each word occupying 45 pulses. The external memory comprises 4 magnetic tape units each of capacity 10^5 words, linking the machine to the output printers. The tape can also introduce additional data, and can be scanned at 500 words/sec. Each unit has two 32-word delay lines. Computation and tape recording can proceed simultaneously. Addition, subtraction, transfer, double-precision, floating point, and 3 types of shift operation are described. A. J. K. (R)

518.5 : 621.318.572

6688. A Bell Telephone Laboratories' computing machine. I. Alt, F. L. *Math. Tables Aids Comput.*, **3**, 1–13 (*Jan.*, 1948).—The subject is treated mainly from the mathematical standpoint, the functioning of the machine being described in general terms only. Numbers are represented on the "bi-quinary system," each decimal digit being replaced by two, one having values 0 to 4, the other either the value 0 or 5, such that their sum = original digit. The merits of this system are compared with others. Numbers are stored to 7 significant figures. Number storage and the methods of calculation are described. Teletype devices are used for reading and perforating paper tape for the input of orders and numbers and for recording the output. A 7-digit number can be read and transferred in 2 sec. Three groups of tape-input are used, designated "problem," "routine" and "table." The necessity for these is critically reviewe their operation being discussed in some detail. A. J. K. (

518.5 : 621.318.5

6689. A Bell Telephone Laboratories' computi machine. II. Alt, F. L. *Math. Tables Aids Compu* **3**, 69–84 (*April*, 1948).—Machine control is discusse This involves the application and representation orders, discrimination, including an additior feature to the usual one (concerned with a count signs), and operational characteristics. The co siderable check system, described, simplifies fa location. The machine speed is slow, but it has high storage capacity, it can handle complicat instructions, and the preparation (setting-up) of problem can be done while the machine is worki on another. A functions table ($\sin x$, $\tan^{-1} x$, et is associated with the register. Some of the proble already handled are briefly discussed. A. J. K. (

519

6690. Random sampling frequencies; an impleme for rapidly constructing large-size artificial sampl Hamaker, H. C. *Proc. K. Ned. Akad. Wet.*, (*No.* 4) 432–9 (1949) *In English.*

519.

6691. Rapid calculation of standard deviatior Woolf, B. Letter in *Nature, Lond.*, **164**, 360 (*Aug.* 27, 1949).—Points corresponding to t different values are placed on a straight line, the mea is found by arithmetic, and the sum of the squar of the deviations from this mean is found by a ge metrical procedure, depending on Pythagora theorem and using only a pair of dividers. The resul are usually within 1% of the calculated valu Correlations and regressions are found by a simp extension. N.

519.25 : 539.6.0

6692. Some statistical considerations on coincider counting. Sard, A. and Sard, R. D. *Rev. Sc Instrum.*, **20**, 526 (*July*, 1949).

ASTRONOMY . ASTROPHYSICS . GEODESY 52

521.12

6693. On the forms of the trajectories in the problem of two bodies with variable masses. Batyrev, A. A. *Astron. J. USSR*, **26** (*No.* 1) 56 (1949) *In Russian.* English summary in *Astron. News Letter* [*Harvard*] (*No.* 45).—The masses are assumed to vary as $M = M_0/(1 + \alpha t)$, where $\alpha > 0$. A simple change of the variables: $\xi = x/(1 + \alpha t)$; $\eta = y/(1 + \alpha t)$; $\tau = 1/\alpha(1 + \alpha t)$ results in a set of differential equations having the classical form of the 2-body problem. The author investigates separately the cases corresponding to elliptical, parabolic, and hyperbolic motion in ξ, η, and draws representative curves for each case in the x, y co-ordinates.

522.615 : 535.242.62

6694. Photoelectric work by the flicker method. Öhman, Y. *Stockholms Obs. Ann.*, **15** (*No.* 8) 3–45 (1949) *In English.*—Gives a detailed account of experiments made from 1942 to 1947 to secure accurate photometric measures of star colours usir the 24 in refractor and the 40 in reflector. Detai of the flicker disc and improved phototubes are give with the results obtained for bright stars. Later rotating polarizer was added, giving simultaneo and frequently repeated comparisons. A method accurately measuring stellar magnitudes phot electrically is described which was applied to stars magnitude 15. These magnitudes prove to b between photographic and visual. Some results work on space-reddened early type stars are given. E. G. M

523

6695. The present status of the problem of cosm gony in contemporary astronomy. Fessenkoff, V. G *Astron. J. USSR*, **26** (*No.* 2) 67 (1949) *In Russia* English summary in *Astron. News Letter* [*Harvar* (*No.* 45).—A general review of the whole proble The first 2 sections are devoted to the criticism

ories which attribute the origin of the planets to teoric matter captured by the sun. Next, the thor emphasizes the importance of considering the olution of the sun as a member of the galaxy. is leads him to propose that the stars of the main quence, including the sun, evolve along this quence, with a loss of mass $dm/dt = \text{const.}\, L$ ributed to some form of corpuscular radiation. this decrease of mass takes place the star remains the mass-luminosity curve, which determines its te of conversion of H into He by the Bethe process. is permits the author to compute the decrease in e H abundance of the star for different ages T, and anges in mass, $k = m_0/m_1$. A few billion years ago e sun had a mass $\gg$ now, and the planetary stem was correspondingly contracted in diameter. the massive, original star evolved, it lost not only ass but also angular momentum. Hence the sun d in the past 2 billion years about the same angular locity as at present. But about 4 billion years ago e mass was about 10 times greater and the angular locity was $\gg$ now. Thus, according to this hypo- esis, the sun was once a normal, rapidly rotating r of 10 solar masses, and therefore of early spectral ss. The origin of the planets is not discussed detail, but is considered to be analogous to the rmation of double stars, and of galactic clusters. ly very close binaries could have resulted from sion, the wider systems must have been produced ultaneously out of the interstellar medium, as dividual condensations. The angular momenta of e members of a newly formed group are the remnants the momentum of the original cloud. The minor nets and meteorites are attributed to the explosion a larger planet, perhaps as the result of a near proach to Jupiter. During a sufficiently close proach the attraction of Jupiter would have pro- ced a sudden decrease of the inner pressure, and s in turn would have caused an equally sudden crease of the heat-capacity and rise in the temp. the gases in the interior of the planet. An explosion uld have resulted, with a break-up of the solid outer ers into pieces ranging from several hundred ometers in diameter to meteors of negligible size. e retrograde satellites are regarded as minor nets captured by the principal planets at a time en the solar system contained a large amount of fuse matter forming a resisting medium.

523.165

96. On the monochromatic radio-radiation of the laxy and the possibility of observing it. SHKLOVSKY, S. *Astron. J. USSR*, **26**, 10 (1949) *In Russian.* glish summary in *Astron. News Letter* [*Harvard*] *o.* 44).—Transitions between levels of the hyper- e structure of the ground state of interstellar H e shown to produce radiation of 1 421·3 Mc/s with nsition probability $0{\cdot}72 \times 10^{15}\ \text{sec}^{-1}$ and Doppler lf-width $\Delta\nu_D = 4 \times 10^4\ \text{sec}^{-1}$. The author dis- sses criteria for an aerial system to detect this diation, which is ~ 20 times more intense than the ntinuous galactic radiation integrated over a ctral range $2\Delta\nu_D$ wide. Other interstellar atoms not produce similar radiations in the radio region, t it is suggested that such radiation is produced by nsitions between sub-levels of the lowest rotational te of the molecules CH, CH^+ and OH. M. W. O.

523.165 + 523.72] : 621.396.822

6697. Cosmic radio noise. HERBSTREIT, J. W. *Adv. Electronics*, **1**, 347–80 (1948).—A review is given of the development of the subject from the first discovery of the phenomenon by Jansky in 1932. The apparatus and methods of measurement are briefly described; some typical recent results of the author and collaborators are analysed and discussed, and the concept of effective temperature explained. A separate section briefly discusses radiation from the sun. (29 refs.)

523.531

6698. Determination of the elements of meteor paths from radar observations. MCKINLEY, D. W. R. AND MILLMAN, P. M. *Canad. J. Res. A*, **27**, 53–67 (*May*, 1949).—Methods of determining meteor velocities from single-station observations are discussed. Where 3-station observations are available both the velocity and the elements of the meteor's path through the atmosphere can be computed in favourable cases. These methods are applied to a selected daytime meteor and lead to an orbit similar to one of the short-period comets. A.

523.63

6699. On the secular acceleration of comets. DUBIAGO, A. D. *Astron. J. USSR*, **25** (*No.* 6) 361 (1948) *In Russian.* English summary in *Astron. News Letter* (*Harvard*) (*No.* 44).—A critical examination of previous work on comets by Encke, Biela, Brookes, Winnecke and Wolf shows that while striking departures from simple gravitational theory occur, these cannot be due to: (*a*) resistance of meteor streams, (*b*) a general resisting medium, or (*c*) radiation pressure. The ratio of the change of angle of eccentricity ϕ' to daily acceleration μ' justifies the assumption that changes occur only near perihelion. If m is the mass of the comet, δm the mass lost per apparition, Δm that lost through all previous apparitions, and v_t the projection of the (unknown) velocity perp. to the radius vector, then $\mu' = f(v_t \delta m/m)$ or $F(v_t \Delta m/m)$. Values of these parameters deduced from observed values of μ' were applied to Bessel's hypothesis of expulsion of matter. It is concluded that the observed accelerations are only to be explained by the expulsion of *solid* particles. M. W. O.

523.63

6700. The new path of the comet Wolf I. KAMIEŃSKI, M. *Bull. Int. Acad. Polonaise Sci. Lett. A* (*Nos* 1–6) 1–18 (*Jan.–June*, 1948) *In English.*—It is demonstrated that the same set of elements do not satisfy the observations in the two periods 1884–1919 and 1925–1942. The change in orbit is shown to have been due to the close approach to Jupiter in 1922. Secular retardation necessary to explain the observations in the earlier period persisted to a lesser degree during the later period. M. W. O.

523.63

6701. Elements and ephemeris of the comet Wolf I for its reapparitions in 1950. KAMIEŃSKI, M. *Bull. Int. Acad. Polonaise Sci. Lett. A* (*Nos* 1–6) 19–23 (*Jan.–June*, 1948) *In English.*

523.63

6702. The influence of Mercury on the motion of the comet Wolf I. KAMIEŃSKI, M. *Bull. Int. Acad.*

Polonaise Sci. Lett. A (*Nos* 1–6) 34–51 (*Jan.–June*, 1948) *In English.*—Analysis of the perturbations by Mercury show that it cannot account for the secular retardation observed. M. W. O.

523.63

6703. Researches on the origin of comet Wolf I. II. The motion of the comet in the sphere of Jupiter's activity in 1875. KAMIEŃSKI, M. *Bull. Int. Acad. Polonaise Sci. Lett. A* (*Nos* 7–10) 53–69 (*July–Dec.*, 1948) *In English.*—The orbit is traced back from the date of discovery, 1884, fully allowing for planetary perturbations. The effect of the close approach to Jupiter in 1875 is calculated by heliocentric and jovicentric methods, the agreement being satisfactory. The suggestion [Schulhoff, *Astr. Nachrichten*, 3127] that Barnard 1892 V might have formed a single body with Wolf I until a close approach to Jupiter in 1815 is rejected by a comparison of the orbits at different periods, and the fact that when full perturbations are taken into account, it is found that no close approach actually occurred in 1815. Perturbations by Mars during the approach in 1898 are small. M. W. O.

523.63

6704. Researches on the origin of the comet Wolf I. III. Heliocentric perturbations due to Jupiter and Saturn in the motion of the comet during the period 1875 Apr. 5·0–1840 May 24·5. KAMIEŃSKI, M. *Bull. Int. Acad. Polonaise Sci. Lett. A* (*Nos* 7–10) 70–102 (*July–Dec.*, 1948) *In English.*

523.63

6705. Researches on the origin of comet Wolf I. IV. The motion of the comet in the proximity of the sphere of Jupiter's activity in 1840–1839. KAMIEŃSKI, M. *Bull. Int. Acad. Polonaise Sci. Lett. A* (*Nos* 7–10) 107–12 (*July–Dec.*, 1948) *In English.*

523.67 : 535.214

6706. Radiation pressure upon molecules in comets and the stratification of molecules in the atmospheres of comets. POLOSKOFF, S. M. *Astron. J. USSR*, **25** (*No.* 6) 343 (1948) *In Russian.* English summary in *Astron. News Letter* (*Harvard*) (*No.* 44).—The ratio $1 + \mu$ of radiation pressure to gravitation is recomputed for 5 common cometary molecules using modern oscillator strengths f. Location of molecules in cometary tails leads to the condition for velocities of expulsion $v_{0(tail)} \ll v_{0(head)}$. Calculations assuming $v_0 = 0$ confirm the author's conclusion that differences of lifetime $\tau_{tail} \gg \tau_{head}$ is not a sufficient criterion for distinguishing head and tail molecules; the latter molecules must absorb in a spectral region where the solar radiation is intense, and $f \sim 1$. τ_{tail} need not be large, the gas being replenished ~ 25 times every perihelion passage. Stratification of molecules in the tail cannot be due entirely to different combinations of v_0, τ and μ; some success is achieved by the assumption that the nucleus emits, in addition to ionized CH_2, CH and OH, solid particles producing cloud-like formations which serve as the source of C_2 and CN. The calculated total number of molecules emitted per apparition is ~ 100 times $>$ current estimates, indicating that present values of cometary masses are falsely low. M. W. O.

523.7

6707. Radio observations of the solar eclipse 28 April, 1949. LAFFINEUR, M., MICHARD, R. STEINBERG, J.-L. AND ZISLER, S. *C.R. Acad. Sc. Paris*, **228**, 1636–7 (*May* 23, 1949) *In French.*—Apparatus for recording solar noise on 195, 55 an 25 cm is described. Percentage diminution received signal at max. phase of eclipse (magnitud 0·38 at Paris) was 50, 21 and 20 for the 3 wavelengt respectively. Occultations of individual sunspo were not recorded. M. W.

523.7

6708. The relation between solar decimetric rad emission and sunspots. DENISSE, J-F. *C.R. Aca Sci., Paris*, **228**, 1571–2 (*May* 16, 1949) *In French.*— Observations on one wavelength (10 cm) betwee March and Oct., 1947 are compared successive with (*a*) sunspot relative number, (*b*) integrate corrected sunspot area, and (*c*) a daily index $\Sigma\sqrt{A}\,.\,H$ where A is the area of a spot whose max. magnet field is H_0. The correlation noted by Covington f (*a*) is shown to hold for (*b*) and (*c*) with correlatio coeffs. $\rho_a = 0{\cdot}53$, $\rho_b = 0{\cdot}76$, $\rho_c = 0{\cdot}87$. Resul for Oct., 1947, to Dec., 1948, are similar, except for drop in ρ_c from 0·9 at the beginning of the perio to 0·7 at the end. Interpretation is in terms of components of noise, (i) due to free-free electro transitions in corona and chromosphere, corr sponding to an apparent temp. of 60 000°, (ii) $\propto$ sp area, equivalent temp. $2\text{–}8 \times 10^6$ °, the improve correlation given by (*c*) suggesting a gyromagnet origin, and (iii) sudden increases of duration 2 or days, interpreted as due to acceleration of coron electrons in the neighbourhood of a spot group induced electric fields associated with observe changes in spot topography. M. W.

523.72 : 537.591

Relations between solar radio emissions and cosm rays. *See Abstr.* 7136

523.72 : 621.396.11.029.

6709. Circularly polarized solar radiation 10·7 cm. COVINGTON, A. E. Letter in *Proc. Ins Radio Engrs*, **37**, 407 (*April*, 1949).—Daily studi of solar radiation on a wavelength of 10·7 cm ov a period of two months, show that this radiati has a small circularly polarized component whi changes slowly from day to day. On the avera there is an excess of left-handed radiation produc by sunspots, but during the period considered the was one definite example of a change from left- right-handed polarization which could be associat with the appearance of a sunspot. W. J. G. B.

523.7

6710. On the empirical representation of the sour function for the solar photosphere. KOURGANOFF, *C.R. Acad. Sci., Paris*, **228**, 2011–14 (*June* 27, 194 *In French.*—Polynomial approximations to $B_\lambda($ are criticized. Observed values of emergent intensit are used to compare Barbier's polynomial [*A d'Astrophys.*, **9**, 173 (1946)] with the author's analyti representation of $B_\lambda(\tau_\lambda)$ [Abstr. 3728 (1949)]. R. A.

523.74

6711. The general form of the 11-year sunspot cyc KOSIK, S. M. *Astron. J. USSR*, **26** (*No.* 1) 28 (19

Russian. English summary in *Astron. News etter* [*Harvard*] (*No.* 45).—Using the quantity $= 10\sqrt{W}$, where W is the usual Wolf number, the ıthor has represented the form of the sunspot curve a family of broken lines, each consisting of 3 raight-line sections. The curves are characterized the fact that the descending branch has the same ope for all cycles, but the other 2 sections vary in ope and in length.

523.75

712. Solar flares and the Zeeman effect. BRUCE, E. R.; ELLISON, M. A. Letters in *Nature*, *ond.*, **164**, 280–1 (*Aug.* 13, 1949).—Bruce suggests at the broadening of the Balmer lines observed in lar flares is due to Zeeman effect, since the widths crease with wavelength and agree numerically with s expected values based on electrical discharges using magnetic fields of $\sim 10^5$ gauss. Additional pport is suggested from the relative values of eeman and Stark effects deduced for *Be* stars. llison doubts this interpretation owing to the absence similar Zeeman broadening in other emission lines id to the inadequacy of the measures of Balmer line idths.

D. L. E.

523.75

713. Results from observations of the total solar clipse of 1945, July 9. II. Photoelectric intensity easurements of the corona and the sun during the clipse. ALFVÉN, H. *Stockholms Obs. Ann.*, **15** *Vo.* 6) 3–10 (1949) *In English.*—A Se barrier-layer pe photoelement was used without a colour filter. he intensity of the solar radiation was reduced by ccessive surface reflections from black plates which ere substituted in turn by mirrors as the eclipse rogressed. The method of calibration during the rtial phases is described. The ratio of the intensity the sun to that of the corona, uncorrected for attered light, was $L_{sun}/L_{corona} = 720\,000$. Curves ow the change of intensity during the partial phases, id a detailed table of the observations is included.

M. W. O.

523.752 : 538.566.3 : 621.396.91

714. The study of solar flares by means of very ng radio waves. BRACEWELL, R. N. AND STRAKER, W. *Mon. Not. Roy. Astr. Soc.*, **109** (*No.* 1) 28–45 949).—Anomalies in the phase of waves reflected om the ionosphere after emission from a long-wave nsmitter are shown to be closely related to the currence of solar flares. The effective height of flection falls by several km in a few min and then es more slowly. The effect is observed either by easuring the phase difference between the ground ave and the reflected wave or by observing the sultant amplitude of both. Phase anomalies are a ore sensitive and more reliable index of flare currence than other ionospheric phenomena, and e course of the disturbance closely follows the ensity of the flare. It is suggested that the method's gh efficiency in detecting flares, its ability to follow eir intensity changes in detail, its accuracy in cording times of beginning and ending, and its dependence of cloud, make continuous recording phase at several stations close to long-wave trans- tters very desirable.

A. HU.

523.755

6715. Problem of the [identification of the] coronal line λ5694·42 Å. SHKLOVSKI, I. S. *Dokl. Akad. Nauk, SSSR*, **63** (*No.* 1) 19–22 (1948) *In Russian.*—The existing literature on the line is discussed and Waldmeier's assumptions are verified by calculating the ratio of the intensities of the lines λ5694·42 Å and λ5446 Å, tentatively accepting Edlen's identification. The ionic distribution of Ca XV on the various levels of the basic state may be found by solving a system of linear equations, each of which is a stability condition of a certain level. 5 levels belong to the configuration $2s^22p^2$, viz. $^3P_0 > {}^3P_1 < {}^3P_2 < {}^1D_2 < {}^1S_0$. The spontaneous transitions from $^1S_0$ lead mostly to the level $^3P_1$. Using Mentzel and Hebb's formula [*Astrophys. J.*, **92**, 408 (1940)] the probabilities of the A_{ik} transitions P_2–$P_1 \rightarrow$ λ5446, P_1–$P_0 \rightarrow$ λ5694 and P_2–$P_1 \rightarrow$ λ5694, P_1–$P_0 \rightarrow$ λ5446 were then calculated. It then appeared that the results for their intensity ratio strongly contradict Waldmeier's figure, 5, thus disproving the assumed identification. The conclusion suggesting itself is that the physical conditions in the region of the emission of the line (regions of marked activity in the solar atmosphere), especially where the kinetic temperature T_e is concerned, must deviate considerably from the normal conditions inside the corona. Waldmeier's statement that the emission regions are the "coldest" parts of the corona must be contradicted. It is far more likely that condensations occur in the incandescent coronal matter, which on cooling produce lower ionization stages of the elements than elsewhere in the corona. The only possible explanation is that although no traces of Ne have ever been found in the solar atmosphere proper, there cannot be any doubt of its existence in considerable quantities in the corona. The crucial experiment for deciding between "hot" and "cold" luminescent regions emitting the yellow line would be the measurement of its half-width, quite feasible during an eclipse.

B. F. K.

523.821

6716. Distribution of intensity on the disc of a star. SOBOLEV, V. V. *Astron. J. USSR*, **26** (*No.* 1) 22 (1949) *In Russian.* English summary in *Astron. News Letter* [*Harvard*] (*No.* 45).—A new, exact and explicit solution is given for the problem of diffuse radiation from a scattering and absorbing medium of large optical thickness. The scattering function $x(\gamma) = \Sigma x_i P_i(\cos\gamma)$ and the ratio of the scattering and absorption coefficients are arbitrary. Tables are given for different values of $\eta = \cos\phi$ and $\lambda =$ ratio of coeff. of scattering to the sum of this coeff. and the coeff. of true absorption. For pure scattering ($\lambda = 1$) the distribution of the intensities is the same in the case of a spherical scattering function $[x(\gamma) = 1]$ and a forward-throwing function $x(\gamma) = 1 + \cos\gamma$. Formulae are given for Rayleigh scattering $x(\gamma) = 3/4\,(1 + \cos^2\gamma)$. Brief references are made to previous solutions of this problem by Ambarzumian and Chandrasekhar.

523.841.11

6717. Interpretation of changes in the contours of emission lines of Nova Aql 1918. MUSTEL, E. P. *Astron. J. USSR*, **26** (*No.* 1) 15 (1949) *In Russian.*

English summary in *Astron. News Letter* [*Harvard*] (*No.* 45).—The peculiar M-shaped contours of the emission lines observed during the secondary minima of the light curve of this Nova are attributed to the radiation of the envelope which is responsible for the principal absorption spectrum. During these minima the temps. of the Nova increased, and consequently its radii decreased. This may have produced a diminution in the emission from the transparent extended envelope, leaving only the emission from the rather opaque principal shell. The emission features of this shell are attributed to the conversion of the kinetic energy of atoms belonging to the Orion spectrum, when they collide with the atoms of the principal shell. In this manner the author finds that the expanding envelope responsible for the Orion spectrum carries away $2{\cdot}8 \times 10^{21}$ g/sec.

523.842.3

6718. The orientation of the lines of apsides of spectroscopic binaries. BLANCO, V. M. AND WILLIAMS, A. D. *Publ. Astr. Soc. Pacif.*, **61**, 93–7 (*April*, 1949).—Data from Moore and Neubauer's Fifth Catalogue [*Lick. Obs. Bull.*, **20**, 1 (1948)] is used for a statistical analysis of the variation of ω with period and spectral class, semi-amplitude of velocity-curve, and $a \sin i$. The Barr effect [*J. Roy. Ast. Soc. Can.*, **2**, 70 (1908)] is found in both eclipsing and non-eclipsing systems, being more pronounced in the latter type, and is correlated with the parameters considered in a manner consistent with their known interrelations. The results are consistent with Struve's hypothesis [Abstr. 1293 (1949)]. M. W. O.

523.851

6719. Introduction to the dynamics of star systems. VON DER PAHLEN, E. *Lehrbücher und Monographien aus dem Gebiete der exakten Wissenschaften*, 10. *Astronomisch-Geophysikalische Reihe, Band I. Verlag Birkhäuser, Basel* (1947) 240 *pp. In German.*—This book is devoted to summarizing and in part extending results of investigations on 2 problems: (1) stellar encounters, and their importance for stellar dynamics, (2) consequences, for dynamical theory, implied by the known kinematics of stellar motions. In the treatment of (1) an earlier investigation of Charlier is largely followed. The treatment of (2) is exceptionally complete and satisfactory. The central problem here is equivalent to that of defining the potential in a dynamical system which admits an integral, other than the energy integral, which is quadratic in the velocities. M. R.

523.851

6720. Stellar associations. AMBARZUMIAN, V. A. *Astron. J. USSR*, **26** (*No.* 1) 1 (1949) *In Russian.* English summary in *Astron. News Letter* [*Harvard*] (*No.* 44).—The author considers 6 typical examples of widely-scattered groups of stars which have average densities < normal for stars in the Milky Way, but which contain unusual stars (early-type and emission-line stars) in terms of which their densities are high. The calculated disruption in the *l*-co-ordinate by galactic rotation shows that such associations must be young. Expansion in the *z*-co-ordinate (due to differences of periods of oscillation) being much smaller, the spherical shape of the associations is attributed to their mode of formation, supposed to be the expulsion of stars in all directions with differer velocities from an original small volume. Age $\sim 10^7$ years are thus found. It is estimated that th total number of such systems is $\sim 10^4$, one bein formed every 10^3 years (from some type of paren object at present unknown). A very large number c galactic stars must have been dissipated from suc associations. M. W. O

523.852.

6721. On the evolution of galaxies into barre spirals. FABRE, H. *C.R. Acad. Sci., Paris*, **228** 1569–71 (*May* 16, 1949) *In French.*—Barred spira might develop from a spheroidal distribution su rounded by a thin equatorial ring. R. A. M

523.852.3

6722. Kinematical criterion of tilt and direction rotation in spiral nebulae. DINGENS, P. *Med. Vlaamse Acad. Wetensch.*, **11** (*No.* 1) 5–17 (1949) *English.*—Stars are assumed to move along visu (logarithmic) spirals with const. angular velocity the spirals rotating with angular velocity ω'. Observe radial velocities are used to determine ω, ω' and th sign of cos (angle of tilt). Application to *M*31 show nearest side *N.W.* with arms trailing, while for *M*3 nearest side is *E.* with arms leading. R. A. M

523.854.1

6723. Average density of matter in the meta-galax EIGENSON, M. S. *Dokl. Akad. Nauk, SSSR*, **6** (*No.* 2) 107–9 (1948) *In Russian.*—Light-absorptio measurements have shown that Jeans's assumption that intergalactic space is practically void of matte and that the average mass of one galaxy is $\sim 10^{42}$ cannot be maintained. His estimate of the averag density in the metagalaxy, viz. 10^{-30} g/cm^{-3}, base on the above assumptions, is thus falsified. Th author's calculations of the cosmic dust-densit causing interstellar absorption lead to a figu identical with Jeans's value for the luminous matte yet this apparent agreement points to the importanc of the dark metagalactic matter, i.e. masses $\sim 10^{-5}$ cm dia. The value thus found mu therefore be $\ll$ total metagalactic density (as repr senting only a single constituent). According Hubble, the linear dimensions of the galaxies a $\sim 10^3$–10^4 l.y., whilst the mean distance of neig bouring galaxies $\sim 10^6$ l.y., whence the "coeff. population" of the metagalaxy (i.e. the ratio of th latter values) $\sim 10^{-2}$–10^{-3}. For the galaxy, howeve the corresponding (star dimensions/star distances) $\sim 10^{-9}$–10^{-10}, i.e. 10^6–10^8 times less. Babcock (193 proved that Jeans's estimate could apply only to th nuclei of the spirals. E.g. the mass of *M*31 in sphere of radius 100′ is $\sim 10^{44}$g, corresponding to th of our galaxy, but only $10^2\times$ the mass of its nucle These and similar considerations lead to an estima of the lower density limit of the metagalaxy 10^{-28}–10^{-27}g.cm^{-3}. This, in turn, may be shown correspond to a value of the mean density 10^{-26} g.cm^{-3} (identical with that in the inter-galac spaces). B. F.

523.854.

6724. The problem of non-selective absorption interstellar space. DUFAY, J. *C.R. Acad. Sci., Par* **228**, 1277–8 (*April* 11, 1949) *In French.*—From pu lished values of the ratio of total interstellar absorpti

f light (at a given λ) to the differential absorption or two other $\lambda\lambda$, it is shown that non-selective bsorption must be negligible. Thus large particles nd free electrons are not sufficiently numerous in pace to affect the total absorption appreciably. D. L. E.

523.877

725. Turbulent velocities in the atmospheres of ed giants. SCHATZMAN, E. *C.R. Acad. Sci., Paris*, **28,** 814–16 (*March* 7, 1949) *In French.*—High elocities are associated with small dissipation in tmospheres with weak gravitational fields. R. A. N.

523.877

726. The monochromatic coefficients of darkening or the main sequence stars. MÜNCH, G. AND CHANDRASEKHAR, S. *Harvard Coll. Obs. Circ. No.* 453) 1–3 (1949).—It is shown that the generally ssumed linear law for the distribution of brightness ver the apparent stellar disc is not compatible with he current theory of the continuous spectrum, even nder strictly idealized conditions. Consequently, alues of the monochromatic darkening coefficient, χ_λ must be regarded as crudely approximate on ccount of the inadequacy of the linear approximation or the Planck function used in predicting the law f darkening. A table of approx. solutions of χ_λ, λ, 3 647 Å to 8 203 Å) for main sequence stars is ncluded. D. R. B.

523.877

727. On the approximate relations of Eddington nd Barbier expressing the law of darkening and the adiant flux as functions of local conditions in a stellar tmosphere. KOURGANOFF, V. *C.R. Acad. Sci., Paris*, **228,** 1931–4 (*June* 20, 1949) *In French.*—[See Barbier, *Ann. Astrophys.*, **6,** 113 (1943)]. Discusses he accuracy of the linear approximation $B(\tau) = a\tau + b$, and concludes that the "parametric repre-entation" $B(x) = F/\phi_0(\tau)$, with $x = \phi_1(\tau)/\phi_0(\tau)$, is a etter approximation. R. A. N.

523.877

728. Stars built on the shell source model. HAYASHI, C. Letter in *Phys. Rev.*, **75,** 1619 (*May* 15, 949).—Continuing previous work [Abstr. 4428 (1949)] ossible structures of stars with dehydrogenized sothermal cores are determined in terms of a parameter giving the central value of the electron degeneracy. Graphs give the luminosity-radius relation, and the relation of stellar radii to core masses, for stars of masses 1 and 8 times the sun's. R. A. N.

525.35

729. Oscillatory series with disturbed self-regression and the Chandlerian polar motion. I–II. NICOLINI, T. *Atti Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) (*Ser.* 8) **6,** 73–9 (*Jan.*); 222–7 (*Feb.*, 1949) *In Italian.*—In preceding papers (*Contr. Astron. Capodimonte, Ser. II*, **3,** *Notes I and II*) the motion of the pole was resolved into an annual and a Chandlerian component. The period of the latter appeared to be variable. In these two notes the author claims that the variability of the period of the Chandlerian term is definitely ascertained. V. C. A. F.

526.92 : 621.396.9

730. Geodetic applications of radar. BOAGA, G. *Ann. Geofis*, **2,** 203–21 (*April*, 1949) *In Italian.*—An outline of the principles of range-finding with a description of some wartime experiments on topographical surveying by means of trilateration (the measurement of distances only). This method allows for the compensation of errors in single measurements. A. C. C.

527

731. The mechanical determination of position and velocity on the earth's surface. FOX, C. *Proc. Camb. Phil. Soc.*, **45** (*Pt* 2) 311–15 (1949).—The problem is solved if the latitude, longitude, and 2 velocity components are known. These are usually obtained by reference to external objects. The paper shows that it is possible to obtain these quantities by the use of 2 gyroscopic instruments. W. A. R.

527.6 : 621.396.9

732. Electronic aids to navigation. PIERCE, J. A. *Adv. Electronics*, **1,** 425–51 (1948).—A very brief qualitative description is given of pre-war methods, wartime developments and postwar proposals. These are then analysed and contrasted on the basis of considerations of range and accuracy, the analysis being illustrated by 13 comparative graphs. No refs. are given.

PHYSICS 53

53.08 : 621.3.012.8

733. Electrical models of physical phenomena. GUTENMAKHER, L. I. *Elektrichestvo* (*No.* 8) 34–40 (*Aug.*, 1948) *In Russian.*—Electrical analogies of physical phenomena have been recognized since the time of Maxwell, who replaced the generalized Lagrangian co-ordinate by electric charge, velocity by current and acceleration by voltage; this scheme is particularly useful for dynamical systems. An alternative method, common in electro-acoustical problems, is to use flux as the analogue of the co-ordinate and voltage as that of velocity. The paper gives a thorough discussion of various electrical models of physical systems in 1-, 2- and 3-dimensions, pointing out the close analogy between the theory of electric circuits with lumped parameters and the performance of such models. A classification of the differential equations of physics and their applications is attempted, together with a discussion of the use of appropriate electrical models. It is concluded that electrical schemes are useful for the investigation of complex systems with given initial conditions; for the suggestion of models replacing the complex phenomenon by systems of circuits upon which measurements can be made; and for the prediction of the behaviour of real systems by the use of a model with a reduced time scale. There is an extensive bibliography of Russian literature. B. H. (R)

FUNDAMENTALS 530.1

530.12

6734. The ideas of mass and energy and the two-body problem in kinematic relativity. CAUSSE, M. *C.R. Acad. Sci., Paris*, **228**, 542–4 (*Feb.* 14, 1949) *In French.*—The arbitrariness in the definitions of mass and energy is discussed, with special reference to the two-body problem. P. M. D.

530.12

6735. The scalar invariants of a general gravitational metric. NARLIKAR, V. V. AND KARMARKAR, K. R. *Proc. Indian Acad. Sci. A*, **29**, 91–7 (*Feb.*, 1949).—A set of 14 independent 2nd-order invariants obtained for space-time reduces to 4 for a spherically symmetric metric, and in this case, the vanishing of the invariants implies flat space. That the latter result is not true in general is shown by constructing a non-flat metric (representing a uni-directional flow of radiation) for which the invariants all vanish. R. A. N.

530.12 : 521.038

6736. On the relations between gravitation and electromagnetism deduced from Codazzi's equations. Application to the general electromagnetic field of stars. GIÃO, A. *C.R. Acad. Sci., Paris*, **228**, 742–4 (*Feb.* 28, 1949) *In French.*—See Abstr. 3745 (1949).

530.12 : 531.51

6737. On Einstein's generalised theory of gravitation. NARLIKAR, V. V. AND TIWARI, R. *Proc. Nat. Sci. India*, **15**, 73–9 (*April*, 1949).—The Hermitian tensor g_{rs} [Abstr. 2008 (1948)] is decomposed into real and imaginary parts, $g_{rs} = a_{rs} + ib_{rs}$, b_{rs} being regarded as small. It is shown that a unified field may be constructed from given pure gravitational and pure electromagnetic fields by a process of successive approximations. R. A. N.

530.12 : 531.51

6738. On Einstein's generalized theory of gravitation. II. NARLIKAR, V. V. AND TIWARI, R. *Proc. Nat. Inst. Sci. India*, **15**, 249–61 (*Aug.*, 1949).—Following Einstein's generalized theory of gravitation of a total field of Hermitian quantities is set up which reduces to the isotropic field of a point mass in classical relativity when the electromagnetic field is switched off, and which provides the classical field of uniform monochromatic radiation ($E_y = H_z = -A\cos 2\pi(x-t)/\lambda$, $E_x = E_z = H_x = H_y = 0$), when the gravitational field is switched off. 4 partial differential equations of the fourth order are obtained for the 4 electromagnetic potentials subject to the condition of continuity. 10 equations for the gravitational field are found. In this case the interaction terms of the second order vanish identically and calculations have been carried out to the third order of approximation. If Einstein's theory is right, the results make a decisive advance in the understanding of the interaction effects, although the gravitational and electromagnetic components of the particular total field set up are idealized abstractions. [See Abstr. 1679 (1949)]. A.

530.12 : 535.31

Interference concept of moving optical images in the theory of relativity. *See Abstr.* 6860

530.12 : 537

6739. The theory of gravitation and electro dynamics. SCHERRER, W. *Helv. Phys. Acta*, 2 (*No.* 1) 89–100 (1949) *In German.*—Mie's theo is modified by introducing the action densi $\{R + \frac{1}{2}\kappa(F_{\lambda\mu}F^{\lambda\mu} + \varepsilon F_{\lambda\alpha}F^{\alpha\mu}F_{\mu\beta}F^{\beta\lambda})\}\sqrt{(-g)}$, whe ε is a small positive constant. The static centr spherically symmetric field is found to have fini energy E, and $\kappa E/8\pi$ is interpreted as the gravita radius. The constant ε is evaluated under th assumption that the field obtained is that of a electron. R. A. N

530.14 : 538

6740. A note on Podolsky electrodynamic MATTHEWS, P. T. *Proc. Camb. Phil. Soc.*, **45** (*Pt* 441–51 (1949).—Podolsky and others [Abstr. 201 (1948)] have suggested a form of electrodynamics i which vector mesons appear together with photon The divergent parts of the two fields cancel and giv finite electron self-energy. However, the vecto mesons, if quantized in the usual way, have negativ energy. It is shown that this gives rise to phenomen such as the emission of vector mesons by electro bremsstrahlung with resultant gain in electro kinetic energy. The negative energy difficulty removed if the mesons are quantized with a indefinite metric in Hilbert space, but then no con sistent physical interpretation of the theory can b given. H. McM

530.14

6741. Refinement of the uncertainty relations i quantum statistics by the introduction of a comple coefficient of correlation. BODIOU, G. *C.R. Acad Sci., Paris*, **228**, 540–2 (*Feb.* 14, 1949) *In French.*— A well-known theorem concerning the product of th dispersions of two operators is made more precise. P. M. D

530.14

6742. The cross-section for nucleon-nucleon col lisions in the super-many-time theory (pseudoscala mesons). JEAN, M. AND PRENTKI, J. *C.R. Acad. Sci Paris*, **229**, 171–3 (*July* 18, 1949) *In French.*—This ha been calculated (in Born approx.) and depends onl on a linear combination of the two possible couplin constants, showing that the two types of coupling ar interchangeable. In this connection the interactio potential has been calculated using this theory an it agrees with the result of Van Hove [Abstr. 445 (1949)]. The cross-sections are sensitive to whethe the charged or neutral theory is used. G. J. K

530.14

6743. The relativistic quantum mechanics of th elementary particles. GREEN, H. S. *Proc. Camb Phil. Soc.*, **45** (*Pt* 2) 263–74 (1949).—Relativistic equa tions of the form $(p \cdot A + iEA_4 + m_1A_5 - im_2)\rho =$ are considered, where the operators A_i, A_4 and A are generalizations of the Dirac matrices α_i, γ_4 an γ_5 obeying the commutation rules $\frac{1}{2}(A_aS_{bc} - S_{bc}A_a) = A_c\delta_{ab} - A_b\delta_{ac}$ and $2S_{bc} = A_bA_c - A_cA_b$ In this paper the A are sums of n sets of commutatin α for particles of spin $\frac{1}{2}n\hbar$. The operator ρ is relativistic density matrix. These equations can b solved for the eigenvalues of the rest mass. Fo spin 1 the equations reduce to the meson equation

$m_1 = 0$) or the photon equations ($m_2 = 0$) or scribe particles of 2 masses m_1 and $(m_1^2 + \frac{1}{4}m_2^2)^{\frac{1}{2}}$. ie algebra of the matrices, which differs from that Kemmer, is carried through for $n = 2$ and 3.

G. J. K.

530.145

'44. On the relativistic interaction of point particles. EITLER, W. *Proc. Roy. Irish Acad.*, **52A** (*No.* 8) 5–108 (*Jan.*, 1949).—In considering the interaction tween particles by means of a quantized field, a atic interaction potential can be split off which is act in the non-relativistic limit, provided spin and otopic spin-dependent interactions can be neglected. he non-static part, however, can only be treated up terms involving the square of the interaction nstant as higher approximations diverge. Consequently a relativistic interaction between particles n only be treated up to terms of this order, and such interaction does not go over to the static potential the non-relativistic limit. An estimate of higher der terms in the relativistic interaction is given, ing the author's theory of radiation damping bstr. 2558 (1942)]. The resultant expression also is not the right form in the non-relativistic limit. compromise formula is suggested which has, but ich is invariant only in the limit of high energies. note added in proof suggests that the more recent ethods of avoiding the divergencies of quantum ld theory proposed by Tomonaga and Schwinger ay lead to a solution of the problem. H. McM.

530.145

'45. Second configuration space and third quantiza-n. NAMBU, Y. Letter in *Progr. Theor. Phys.*, **4**, 5–8 (*Jan.–March*, 1949) *In English.*—The calculus of e ordering of operators required by the covariant any-time field theory is developed into a formalism here these operators appear as state-functions. This nplifies the expression of this theory and of other neralized theories. G. J. K.

530.145

'46. A note on the spin in Bhabha's theory of ementary particles. GUPTA, K. K. *Proc. Indian cad. Sci. A*, **29**, 274–6 (*April*, 1949).—A proof is ven of a statement that the wave-equation given by irreducible representative $R_s(m, n)$ of the 5-mensional Lorentz group corresponds, in non-lativistic approx., to an equation describing a rticle of spin m in its state of lowest rest mass f. Abstr. 1632 (1946)]. G. J. K.

530.145

'47. The uniqueness theorem for the solution of the mmutation relations in quantum mechanics. RELLICH, *Nachr. Wiss. Göttingen* (*No.* 2) 107–15 (1946) *In erman.*—It is proved that the well-known solution the commutation relation $PQ - QP = h/i$, where and Q are Hermitian operators (matrices) of a ilbert space, is unique. The result is extended to ts of operators $P_1, \ldots, P_n$; $Q_1, \ldots, Q_n$, where the erators of each set are commutative and $Q_j - P_jQ_i = h/i$. L. S. G.

530.145

'48. On simultaneous interaction of several fields d the self-energy problem. RAYSKI, J. *Acta Phys. lon.*, **9** (*Nos* 2–4) 129–40 (1947–48) *In English.*—The particular problem investigated is photon self-energy. This must be zero for a gauge-invariant theory. The electromagnetic field is taken in interaction with the electron field, another spinor field of charge e_1 and mass m_1, and two scalar fields whose charges and masses are e_2e_3, m_2m_3. The photon self-energy to second order in the interaction constant is shown to vanish if 3 relations between the constant e_i and m_i are satisfied. The calculation starts from the interaction representation of Schwinger and Tomonaga and involves integrals over the usual singular invariant functions. These are specified by their 4-dimensional Fourier transforms and the integrals carried out without imposing any other restriction on their behaviour. It is stated that further fields must be added to secure finite self-energies for charged particles and that it is not certain whether conditions valid for second-order effects would secure the convergence of higher orders. H. McM.

530.145

6749. Quantum-mechanical treatment of multiple processes. DALLAPORTA, N. *Nuovo Cim.* (*Ser.* 9) **6** (*No.* 4) 255–64 (*July*, 1949) *In Italian.*—A series expansion of the matrix element of the electrostatic interaction responsible for Bremsstrahlung makes it possible to separate the contributions corresponding to different values of the angular momentum. This method is similar, and gives similar results, to the Weizsäcker–Williams procedure. L. P.

530.145 : 537.122

6750. On the classical equations of motion of radiating electrons. ASHAUER, S. *Proc. Camb. Phil. Soc.*, **45** (*Pt* 3) 463–75 (1949).—The theory used is that of Dirac [Abstr. 3660 (1938)]. In the first half of the paper it is shown that the electromagnetic field energy is concentrated in a disc perpendicular to the motion of a self-accelerating electron. In the second half, the motion of an electron in the relativistic region under the influence of an electromagnetic pulse is considered, and the effects of damping are shown when the pulse has large intensity. H. McM.

530.145 : 538.3

6751. Quantum electrodynamics. II. Vacuum polarization and self-energy. SCHWINGER, J. *Phys. Rev.*, **75**, 651–79 (*Feb.* 15, 1949).—The covariant electrodynamics already developed [Abstr. 3764 (1949)] is applied to the polarization of the vacuum and the self-energies of the electron and photon. The vacuum of non-interacting fields is suitably defined and expressed using a decomposition of field operators into positive and negative frequency components. The current induced in the vacuum by an external electromagnetic field consists of a divergent multiple of the external current, producing an unobservable renormalization of charge, and a more significant finite term, agreeing with previous work. A light wave induces no current in the vacuum. The effect of vacuum fluctuations on the electron field due to the interaction is considered either using the supplementary condition or without it. Equations of motion are then constructed with the first-order interaction term transformed into a second-order term. From the self-interaction terms in this, it is shown that the light quantum self-energy vanishes, and the corresponding term for the electron corresponds to a

(divergent) change in mass which can be eliminated by renormalizing. It is shown that the renormalization accounts successfully for all effects of the self-interaction. G. J. K.

530.145 : 538.3

6752. An invariant classification of the terms of the matrix *S*. HOURIET, A. AND KIND, A. *Helv. Phys. Acta*, **22** (*No.* 3) 319–30 (1949) *In French.*—To eliminate the divergences in the solution by perturbation methods of the integral form $\psi = S\psi$ of the field equations it is useful to decompose the terms of each order into classes invariant under the Lorentz group. The decomposition is described in terms of the theory of graphs [Abstr. 2338 (1949)]. G. J. K.

530.145 : 539.18

6753. Interaction Hamiltonian for photon, meson and nucleon fields. YEVICK, G. J. Letter in *Phys. Rev.*, **75**, 1450–1 (*May* 1, 1949).—Using the method of Tomonaga, this has been obtained for vector mesons interacting simultaneously with nucleons and the e–m. field. G. J. K.

530.145 : 539.18

The interaction of point particles with charged fields. *See Abstr.* 7288

530.145 : 539.185

Relativistic scattering of neutrons by protons. *See Abstr.* 7307

530.145 : 539.185

6754. A method of eliminating infinities in the theory of quantized fields. An application to the magnetic moment of the neutron. RIVIER, D. *Helv. Phys. Acta*, **22** (*No.* 3) 265–318 (1949) *In French.*—An integral equation $\psi(\tau) = S(\tau', \tau)\psi(\tau')$ gives the development of the wave-function between arbitrary space-like surfaces τ' and τ. S is a unitary integral operator based on the Hamiltonian, and each term of its expansion is made invariant. The method is formally applied to scalar and spinor fields. It is then used to calculate the neutron magnetic moment in third order, using a pseudoscalar meson field. The moment is made finite and unambiguous by a suitable choice (regularization) of S. [Abstr. 3957 (1948) and 1174 (1949)]. G. J. K.

530.145 : 539.185

6755. Reaction of meson field on nucleon. BABA, K. AND ITÔ, D. Letter in *Progr. Theor. Phys.*, **4**, 95–6 (*Jan.–March*, 1949) *In English.*—An application of the Tomonaga–Schwinger formulation is made to a scalar meson-nucleon field. The nucleon mass renormalization term and the vacuum polarization of the scalar meson field by the vacuum nucleon field are given. G. J. K.

530.145.6

6756. General form of differential hermitian operators. YVON, J. *Cah. de Phys.*, **33**, 25–30 (*Oct.*, 1948) *In French.*—The 2 operators, P and X, where $P\psi = -i\hbar d\psi/dx$ and $X\psi = x\psi$, are considered. The relation $PX - XP = -i\hbar$ allows any operator which is the sum of power products of P and X to be written in the form $G = \Sigma A_{ij} X^i P^j$, where, in each term X precedes P. The function $g = \Sigma A_{ij} x^i p^j$ is said to be the generating function of G and determines G uniquely. When G is given, but now in canonical form, g may be found from the formula $g = \exp(-ipx/\hbar)G\exp(ipx/\hbar)$. This is generalized. G is hermitian and a is the real part of g, then g given by $g = a + \tanh(-\frac{1}{2}i\hbar\partial^2/\partial x\partial p)a$. L. S.

530.14

6757. The expression of the non-relativistic eig functions for a particle with positive energy in Coulomb field. FRANCHINI, S. *Nuovo Cim.* (*Ser.* **6**, 274–82 (*July*, 1949) *In Italian.*—An asympt expression is obtained by an extension of W.K.B.-method, which for large r provides a g approximation and converges rapidly. L

530.14

6758. On the intuitive approach to the spectrum a wave equation. HARTMAN, P. AND WINTNER, Letter in *Phys. Rev.*, **75**, 1452–3 (*May* 1, 1949) After a brief discussion of eigenvalue problems i shown by an example that the intuitive conditi that $\phi(x)$ is bounded at infinity, is not sufficient determine a positive eigenvalue λ of the equati $\phi'' + [f(x) + \lambda]\phi = 0$, if $f(x) \to 0$ when $x \to \infty$. G. J.

530.14

6759. A general theorem on the transition pr abilities of a quantized system with spatial degenera DE GROOT, S. R. AND TOLHOEK, H. A. *C.R. Acad. S Paris*, **228**, 1794–6 (*June* 8, 1949) *In French.*— general proof for all processes has been found of theorem: the probability of a process is the same all spatially degenerate initial states, provided that Hamiltonian is invariant under rotations. T theorem is discussed. G. J.

530.14

6760. A method of approximation adapted to wave-equations of particles with spin, and a new se classical mechanics of these particles. KWAL, *C.R. Acad. Sci., Paris*, **228**, 1634–6 (*May* 23, 1949) *French.*—Dirac equations containing the most gene tensor interaction term derivable from the matrices and their products can be solved in the fo $\psi = A\exp(iS/\hbar)$, where $S = \Sigma_n(S^{(n)} + \gamma_\mu S^{(n)}_\mu + \ldots$ subject to compatibility relations between the vari $S^{(n)}$. G. J.

530.145.6 : 53

6761. The operator of the energy of electr magnetic interaction between charged particl VALATIN, J. G. *C.R. Acad. Sci., Paris*, **228**, 1283 (*April* 11, 1949) *In French.*—The ordered interacti operator U in the wave-equation $i\hbar\partial\psi/\partial t = H$ obtained by a canonical transformation from equations of electrons is split into its longitudinal a transverse parts, and its matrix elements examined invariance and for comparison with earlier expressio G. J.

530.145

6762. The Schrödinger wave field. FALK, G. A MARSCHALL, H. *Z. Naturforsch.*, **4a**, 131–6 (*M* 1949) *In German.*—The Schrödinger theory is treat as a field theory. In particular, the conser tion theorems are considered. The nature of stress tensor is illustrated by examples. P. M.

530.145

6763. Rational corrections on Dirac's equati GALANIN, A. D. *J. Exp. Theor. Phys., USSR*,

21–34 (*June*, 1949) *In Russian.*—The interaction is onsidered of an electron with the zero oscillations of ne electromagnetic field and with a background of lectrons of negative energy, with an accuracy of the rder of the square of the electron charge. The nfinite electromagnetic energy of the electron is ombined with the "mechanical" mass in the "experiental" mass of the electron. The identification of ne terms with their characteristic masses is carried rough in such a way that the mass in Dirac's amiltonian is multiplied into the matrix β. The maining finite operator is considered as the hysically observable result of the interaction of the lectron with the zero oscillations of the field. This perator determines the shift of the energy levels of ne H-atom [Lamb and Retherford, Abstr. 3606 1947)] and the anomalous magnetic moment of the lectron. B. F. K.

530.145.7

6764. Determination of the potential from the symptotic phase. LEVINSON, N. Letter in *Phys. ev.*, **75**, 1445 (*May* 1, 1949).—See Abstr. 1704 1949).

530.162 : 621.317.715.5

6765. Limit of amplification of a galvanometer eflexion. HILL, A. V. Letter in *Nature, Lond.*, **163**, 94–5 (*June* 25, 1949).—A given high-sensitivity alvanometer was set up for photocell amplification nd c.r.t. display, with a resulting sensitivity of $\cdot 4\times10^{-10}$ A/mm. Single sweeps were recorded, ach consisting of 50–60 "instantaneous" spots at ·02 sec intervals. Eight such sweeps are reproduced. he plates were projected on to squared paper and he spots marked in pencil. Over 1 000 such spots ere recorded and their deviation from a mean line neasured. The Brownian movement can be calulated, the observed deviation being 1·5× this. E. H. W. B. (R)

GENERAL MECHANICS MECHANICS OF SOLIDS 531

531.224.8 : 621–272

6766. On highly compressible helical springs and ubber rods, and their application for vibration-free nountings. II. HARINGX, J. A. *Philips Res. Rep.*, **4**, 9–80 (*Feb.*, 1949).—Gives the calculation of the ateral rigidity of helical springs under compression nd their natural frequencies for transverse vibration, reating as in Pt I the helical as an elastic prismatic od with due allowance for the rigidity against hearing. Although, here too, this simplification eads to reliable results, the fact that the spring is ctually a helically wound wire structure requires pecial attention in respect of the spring ends, which re either rigorously fixed or elastically constrained by neans of flat-wound end coils. Special precautions, vithout which the central line of the spring when ompressed takes a curved and oblique position, are ndicated for the two cases separately. Particular ttention is drawn to the negative lateral rigidity of elical springs, occurring at certain compressions, and important for compensating another positive rigidity. See Abstr. 1706 (1949). A.

531.224.8 : 621–272

6767. On highly compressible helical springs and rubber rods, and their application for vibration-free mountings. III. HARINGX, J. A. *Philips Res. Rep.*, **4**, 206–20 (*June*, 1949).—Deals with the elastic stability and the lateral rigidity of solid rubber rods under axial compression. The calculations are based upon equations derived in the preceding papers for the elastic prismatic rod replacing the helical spring. If the rubber rods are vulcanized or affixed in some other way to metal pieces, at their ends a thin layer of material is to be regarded as fully incompressible, although this layer retains its elasticity in respect of shearing. The corresponding effect upon the lateral rigidity is taken into account. A.

531.261 : 550.831

A line-integral method of computing the gravimetric effects of two-dimensional masses. *See Abstr.* 7455

531.51 : 530.12

On Einstein's generalized theory of gravitation. *See Abstr.* 6737

531.66

6768. Retardation of a cone falling upon sand. FELDTKELLER, R. AND WILDE, H. *Frequenz*, **3**, 29–38 (*Feb.*, 1949) *In German.*—A cone, of angle α, with vertex pointing downwards, is dropped from a given height, h, on to a horizontal layer of sand. The penetration of this layer is studied. Curves are drawn showing the depth of penetration, the time taken, etc., and the dependence of these on α and h, and the mass of the cone. L. S. G.

MECHANICAL MEASUREMENTS 531.7

531.714 : 621.317.39

6769. Direct reading microdisplacement meter. ARNDT, J. P., JR. *J. Acoust. Soc. Amer.*, **21**, 385–91 (*July*, 1949).—Equipment has been built for measuring vibratory displacements of very small mechanical elements such as phonograph styli and piezoelectric crystals. It employs a probe of small dimensions so that virtually point measurements may be made. The probe does not contact the point under measurement and therefore imposes no mechanical load. The variation in capacitance between probe and vibrating surface is used to measure the displacement. Through the use of a built-in calibrator, the sensitivity may be adjusted electrically for direct meter reading of vibratory displacement without precise adjustment of condenser plate spacing. Displacement amplitudes of $< 10^{-6}$ cm may be measured. The output signal corresponds accurately to the displacement both in magnitude and in phase over a wide frequency range so that complex vibrations are portrayed accurately on a c.r.o. The equipment has been calibrated by 4 independent methods, including a reciprocity method, with close agreement. A.

531.717 : 621.317.39

6770. H.f. methods of measuring small displacements. FRITSCH, V. *Arch. tech. Messen* (*No.* 159)

*T*4–5 (*Jan.*, 1949) *In German.*—A general discussion of the capacitance-variation method. The displacement is applied to a variable capacitor forming part of the tuned circuit of an oscillator. The displacement can be found from the change of frequency; a heterodyne method can be used. Several applications are mentioned. C. F. B. (R)

531.76 : 621.317.49

6771. A magnetostrictive accelerometer. WILDE, H. AND EISELE, E. *Z. angew. Phys.*, **1**, 359–66 (*May*, 1949) *In German.*—The accelerometer comprises a Ni core with a mass attached at one end and surrounded by a pick-up coil. The instrument is designed for accelerations up to 1 000 g. The design of the magnetic circuit is discussed. Calibration of the instrument was done by attaching it to a conical plunger falling freely from various heights into sand, the deceleration being computed from the penetration into the sand. It is essential that the nickel core be properly aged, otherwise spurious deflections will be obtained. Details are given of the integration circuits employed with the instrument. A. C. W.

531.787 : 621.317.39

6772. Electronic pressure gauge. PRIME, H. A. AND CHI, T. J. *Engineer, Lond.*, **187**, 320–2 (*March* 25, 1949).—Describes an instrument for recording changes of the order of 1 in of water in the pressure of air in a duct. A rubber membrane carries a piece of Pb foil near the coil of an oscillator. Movement of the diaphragm changes the amplitude of oscillation, which is measured by a valve-voltmeter and recorded on a c.r.o. with a linear time base, obtained from a motor-driven potentiometer. C. F. B. (R)

531.787.9 : 621.317.39.082.74 : 621.944

6773. Inductive equipment for determination of rolling mill pressures. DE BALL, N. *Arch. tech. Messen* (*No.* 158) *T*118–19 (*Dec.*, 1948) *In German.*—Various types of apparatus for recording rolling mill pressures are described, including the Pratt and Whitney electro-limit gauge and the A.E.G. gauge. Details are given of new apparatus developed in Germany in which, as in the earlier equipment already mentioned, the rolling mill pressures are determined from the strain of the mill frame. The strain recording equipment is attached between two points on the frame and the relative movement of these points moves an armature placed between two electromagnets forming two arms of an a.c. bridge. The movement of the armature disturbs the bridge balance and gives a deflection on a rectifier galvanometer circuit which is, in certain circumstances, fitted with continuous recording equipment. The sources of error are discussed. A. C. W. (R)

531.788.13

6774. Investigations on the radiometer function and the Knudsen radiometric force. WEBER, S. *K. Danske-Vidensk. Selsk. Mat.-fys. Medd.*, **21** (*No.* 1) 1–57 (1944) *In German.*—Using the modified form of Maxwell's boundary condition [see Abstr. 1439 (1938)] an expression for K, the radiometric force, valid over the whole region $0 \leqslant \mu/\lambda \leqslant \infty$, where μ is a factor depending on the dimensions of the apparatus and λ is m.f.p. of the gas, is derived. It is shown that $K = F(p) \cdot \Delta T$ where $F(p)$ is the radiometer function, p the gas pressure and ΔT the tem difference between the radiometer surfaces. ΔT in general dependent not only on the form a dimensions of the radiometer system but also on t pressure and nature of the gas. For the sphe plane circular disc, round fibre, or flat band, $F(p)$ $Ap/[1 + \beta p(\mu/\lambda) + \alpha p^2(\mu/\lambda)^2]$, where A is depende on the dimensions and accommodation coeff. of t radiometer, λ corresponds to 1 bar, and α and β a dependent on the dimensions of the radiomet system. The formulae are compared with the ava able experimental values for the Knudsen radiomet force and in particular with the work of Rasmuss [*K. Danske-Vidensk. Selsk. Mat.-fys. Medd.*, **11**, (1932); **13**, 9 (1935)] who used H and air. For the agreement is good both qualitatively a quantitatively. S. V

MECHANICS OF FLUIDS 532

532.1

6775. The laws of friction in a liquid film of min mum thickness. ANDRÉ, M. *C.R. Acad. Sci., Par* **228**, 650–1 (*Feb.* 21, 1949) *In French.*—Numeric results are recorded showing relative values of friction couple, load and viscosity of a liquid, f films of minimum thickness. The laws of frictio deduced from these results, are: (1) friction is ind pendent of load over load range applied; (2) frictic diminishes very slowly as viscosity increases. The laws differ from the law of Amontons–Coulomb a from the law of Newton. G.

532.13 : 537.3

6776. Electroviscosity. IV. Some extensions of t theory of flow of liquids in narrow channels. ELTO G. A. H. AND HIRSCHLER, F. G. *Proc. Roy. Soc.* **198**, 581–9 (*Sept.* 7, 1949).—Previous theoretic work [Abstr. 3786 (1949)] on electroviscosity extended and modified, with special reference to t simplifying assumptions necessary in the derivatic of the equations.

532.13 : 539.8

6777. Viscosities to 30 000 kg/cm². BRIDGMA P. W. *Proc. Amer. Acad. Arts Sci.*, **77**, 117–2 (*Feb.*, 1949).—Measurements have been extende from 12 000 kg/cm² by timing the fall of a var swinging in the liquid. The results cover, among others, various alcohols and 4 dimethyl siloxa polymers. Ultimately the viscosity increases wit pressure more rapidly than exponentially. The pre sure at which deviation occurs is lower for liquic with complicated molecules and the rate of deviatio is more rapid. The author suggests that the resul support his postulated "interlocking" effect a confirm that some essential modification is necessa to the concepts of Frisch, Eyring and Kinkaid. A. J. K

532.13

6778. Measurement of viscosity of fluids at elevate pressures. I. Apparatus for pressure range up 200 atmospheres and for temperatures up to 150 FRITZ, W. AND WEBER, W. *Angew. Chem. B*, 1 123–7 (1948) *In German.*—The principle of t viscometer is that of a Höppler instrument enclose

in a pressure vessel. Detailed descriptions of the pressure chamber, the viscometer proper, pressure-tight electric connections, the thermostat, pressure build-up system and temp. and time measurement are presented. Several sample determinations are described. F. A.

532.137

6779. Measurement of viscosity of fluids at elevated pressures. II. Investigation of viscosities of oils at pressures up to 1 000 atmospheres and temperatures up to 120°. WEBER, W. *Angew. Chem. B*, **20**, 89–96 (*April*, 1948) *In German.*—A falling-ball method was used to determine the effect of pressure on the viscosity of oils. 9 oils were investigated with an improved apparatus from 1 to 200 atmospheres and at 120°. 12 more oils were investigated in an older apparatus up to 1 000 atmospheres and up to 60°. Paraffinic mineral oils show less pressure effect on viscosity than naphthenic oils when compared at equal viscosity. The pressure coeff. of viscosity can be correlated with the viscosity pole height of Ubbelohde in a manner satisfactory for technical purposes. The experimental details and evaluation of results are presented and considerable data are given. F. A.

532.137

6780. German viscometry—new apparatus for very heavy liquids. WILLENBERG, H. AND FRITZ, W. *Angew. Chem. B*, **20**, 134–9 (1948) *In German.*—Investigation of viscosity and flow of very viscous liquids or plastic masses—liquids not conforming to Newtonian laws—requires instruments which can be used with high flow resistances, and which permit study of flow and shear stress with repeated tests of the same sample. Such an instrument was designed by the German Office of Weights and Measures, Thuringia. It consists mainly of two cylinders connected by a capiliary, and two loaded pistons, the liquid being forced by one piston to the second cylinder through the capillary and then back again by the second piston. The instrument is described in detail and formulae for series of curves worked out. F. A.

532.2

6781. Bénard cells in liquids studied by optical methods. KELKAR, V. N. *Proc. Indian Acad. Sci. A*, **29**, 65–71 (*Feb.*, 1949).—A method of observing these cells (formed in thin layers of liquids when the density distribution is unstable) is described which does not involve the introduction of solid "tracer" particles which might modify the liquid movement. The behaviour of ether, benzene, alcohol, CS_2, CCl_4, coconut oil and groundnut oil, was investigated, and photographs are given, showing the different size of cell obtained with different thicknesses and temps. of the liquids. N. C.

532.5

6782. On certain properties of the curl of a field vector which is zero on the boundary of the domain for which it is defined. BERKER, R. *C.R. Acad. Sci., Paris*, **228**, 1630–2 (*May* 23, 1949) *In French.*—According to a result given by de Feriet [*Math. Mag.*, **21**, 74–9 (1947–48)], if two partial derivatives of the first order of a function $\psi(x, y)$, defined in a certain domain, are zero on the frontier of the domain, the Laplacian of $\psi(x, y)$ is orthogonal to every harmonic function in the domain. This theorem is applied to hydrodynamical problems involving rotation within a domain not plane but spatial, and results are expressed in 4 separate theorems. G. G.

532.516

6783. On the kinetic energy of a viscous incompressible fluid occupying a limited domain in space. BERKER, R. *C.R. Acad. Sci., Paris*, **228**, 1327–9 (*April* 20, 1949) *In French.*—Certain results relating to decrease of kinetic energy of a viscous incompressible fluid in plane movement in a limited plane domain, established by Leray [*J. Math.*, **13**, 331–418 (1934)], are here extended to apply to spatial movement. [See also Abstr. 1450 (1948)]. G. G.

532.516

6784. On the steady motion of viscous liquid in a corner. DEAN, W. R. AND MONTAGNON, P. E. *Proc. Camb. Phil. Soc.*, **45** (*Pt* 3) 389–94 (1949).—An approximate form for the stream function representing motion in a corner, $\theta = 0$, α, is $r^m f(\theta)$. This solution was commented upon by Rayleigh who considered it also in its application to the analogous problem of the bending of a thin plate clamped at boundaries $\theta = 0$ and $\theta = \alpha$. A more complete solution of the problem of motion in a corner, expressed as an infinite series of terms, is now given and the limitations involved in Rayleigh's argument are pointed out. The solution given is in agreement with results obtained by Dixon for plates clamped along straight edges: *Proc. Lond. Math. Soc.* (2) **19**, 373–86 (1921); *J. Lond. Math. Soc.*, **9**, 61–74 (1934)]. G. G.

532.516

6785. The measurement of kinetic boundary friction with reference to specifications for lubricating oils. BARWELL, F. T. AND MILNE, A. A. *J. Inst. Petrol.*, **35**, 455–84 (*July*, 1949).—Measurements of kinetic boundary friction are discussed in relation to their utility in characterizing the "oiliness" of a lubricant. It is shown that "oiliness" is not a unique property of a lubricant, but that friction varies widely with such factors as speed of sliding, roughness and hardness of surfaces, and temp. A.

532.516

6786. The lubrication of metal surfaces by mono- and multi-molecular layers. GREENHILL, E. B. *Trans. Faraday Soc.*, **45**, 631–5 (*July*, 1949).—A study has been made of the boundary lubricating properties of stearic acid, ethyl stearate, octadecyl alcohol and the stearates of Cu and Ag. Layers of these compounds were deposited, by the Langmuir–Blodgett method, on a flat metal surface and the friction between this surface and a clean slider of the same metal was measured. The minimum number of layers required to provide effective lubrication depends on the compound and metal used. Where a metal can be lubricated by a solution of one of these compounds in paraffin oil one or 3 deposited layers suffice, but where a paraffin solution does not provide lubrication more than 3 layers are necessary. This indicates that where paraffin solutions do effect lubrication the sliding surfaces are only separated by the monolayer adsorbed on each surface. The results

for Pt and Ag show that metal stearates are more effective lubricants than stearic acid itself. The temps. at which these deposited layers cease to lubricate have been determined. In agreement with the results of other workers it is shown that breakdown of lubrication occurs at the bulk m.p. of the compound except with stearic acid on a reactive metal where lubrication persists up to a temp. which corresponds roughly to the softening point of the appropriate metal soap. A.

532.517.4

6787. On some properties of the function of total correlation. AGOSTINI, L. *C.R. Acad. Sci., Paris*, **228**, 810–11 (*March* 7, 1949) *In French.*—The total correlation function is defined by an equation involving the mean square total velocity of turbulence. It is shown to obey an equation of the heat conduction type in 3-dimensional space, and to lead to the formulae of decrease of turbulence with time. G. G.

532.517.4

6788. Development of the theory of turbulence. ICHIROO, T. *J. Soc. Appl. Mech. Japan*, **2** (*No.* 7) 11–18 (1949) *In Japanese.*—The author summarizes the results of the last fifty years of research into turbulence. D. F. M.

532.517.4

6789. The spectral function of isotropic turbulence. AGOSTINI, L. *C.R. Acad. Sci., Paris*, **228**, 736–8 (*Feb.* 28, 1949) *In French.*—The spectral functions are defined and their investigation is considered from various standpoints in the theoretical and experimental study of turbulence. G. G.

532.517.4

6790. The application to turbulence measurements of a law on the null-points of stochastic functions. LIEPMANN, H. W. *Helv. Phys. Acta*, **2** (*No.* 2) 119–26 (1949) *In German.*—It has been shown by Rice [*Bell Syst. Tech. J.*, **23**, 282 (1944); **24**, 46 (1945)] that, subject to certain conditions, the number of null-points of a stochastic function is directly related to the mean square of its derivative. The necessary conditions are approx. but not exactly fulfilled by the velocity fluctuations in an isotropically turbulent stream. Rice's relation has been applied to the estimation of the characteristic length for dissipation (λ), and the values of λ thus obtained are compared with those obtained by 3 other methods. Variation between the 4 different estimates of λ^2 is of the order of 10%. Sources of error in the null-point method are believed to include an insufficient allowance for the finite time-resolution of the measuring apparatus, and the influence of either a departure from a Gaussian distribution of velocity fluctuations or a difference between space- and time-differentials. A. SCH.

532.517.4

6791. On the decay of isotropic turbulence. CHANDRASEKHAR, S. Letter in *Phys. Rev.*, **75**, 1454–5 (*May* 1, 1949).—Commenting on a recent paper by Heisenberg [Abstr. 4525 (1949)], it is pointed out that Heisenberg discusses the behaviour of the solution of an integral equation when the independent variable $\to \infty$, whereas the range of this variable is finite. This implies that when the Reynolds number is finite there is a minimum eddy-size during turbulent decay, the size increasing with time as $t^{\frac{1}{2}}$. A. SCH.

532.528 : 534.2

6792. Cavitation erosion by irradiation with sound waves. SHALNEV, K. K. *Dokl. Akad. Nauk, SSSR*, **67** (*No.* 1) 33–6 (1949) *In Russian.*

532.542.

6793. Diffusion from a stream flowing through a cylindrical tube. GORMLEY, P. G. AND KENNEDY, M. *Proc. Roy. Irish Acad.*, **52 A** (*No.* 12) 163–9 (*May* 1949).—The flow is along the ζ-axis, and r is the ratio of the number of nuclei at distance ζ to the number at the entrance, $\zeta = 0$. The equation satisfied by the pressure is set up and solved analytically, and the result is used to derive an expression for r. The solution is to be used for the experimental determination of the diffusion coeff. L. S. G.

532.582.

6794. Note on the zones of unequal luminosities observed in certain visualizations of flows. BOUROT, J.-M. AND MOREAU, J.-J. *C.R. Acad. Sci., Paris*, **228**, 1628–9 (*May* 23, 1949) *In French.*—The flow of fluid is studied by a chronographic method, indicating light effects caused by differences in orientation of particles or by the structure of the velocity field. In the case of flow round a cylinder of revolution experimental results are in accord with a geometrical theory proposed. G. G.

532.5

6795. The transmission of energy by gravity waves of finite height. STARR, V. P. AND PLATZMAN, G. W. *J. Mar. Res.*, **7**, 229–38 (*Nov.*, 1948).—Mathematical formulae are derived for the transmission of energy across a vertical plane, due to the arbitrary 2-dimensional motions of a layer of ideal fluid under gravity, without the simplifying assumption of infinitesimal wave amplitude made in the classical theoretical treatment by Reynolds and by Rayleigh. First, an expression is deduced for the rate of energy transfer in a fluid across an arbitrarily fixed vertical; this expression is called the energy-transmission function. The developed concepts and expressions are then applied to the case of periodic waves in a deep basin, and it is shown that the energy transmitted during one wave period is equal to twice the kinetic energy of the horizontal motions per wavelength. Calculation of the ratio of the energy transmitted during one wave period to the total wave energy per wavelength shows that the classical small-amplitude theory, according to which the ratio of transmitted energy to energy "density" $= \frac{1}{2}$, represents only a special case of the general theory developed by the authors. The individual contributions to the transmission function of the advection of kinetic energy, the work done by pressure forces, and the advection of potential energy are examined and mathematically defined. It is found that the amount of potential energy transported by the wave motion in one wave period = the amount of kinetic energy transported in the same period. A. M. R.

532.593 : 551.46

6796. The question of the formation of sea waves by wind. KAPITSA, P. L. *Dokl. Akad. Nauk, SSSR*, **64** (*No.* 4) 513–16 (1949) *In Russian.*

CAPILLARITY 532.6

532.6.03

6797. Gas bubbles in liquids. SEELIGER, R. *Naturwiss.*, **36** (*No.* 2) 41–8 (1949) *In German.*—A general discussion of bubbles formed in various ways. The formation of bubbles on a solid surface is considered from the point of view of interfacial tension, the usual formulae being quoted. Such bubbles may be formed by heating a liquid or during electrolysis and the dependence of the bubble size on electrode potential is shown graphically. With free bubbles there is an exchange of gas between the bubble and the liquid, and this aspect is considered theoretically. The rate of rise of a bubble depends on its size and on the distortion which may take place, and this can be expressed in terms of a Reynolds number. Comparison between solid spheres and air bubbles is shown in a graph. For many purposes it is desirable to produce bubbles and the use of jets and porous plates is described. A table gives pore diameters and corresponding bubble diameters while two photographs show the difference in bubble size for air in water and alcohol. E. H. D.

532.61

6798. A simple derivation of an expression for the surface tension of liquids. SCHYTIL, F. *Z. Naturforsch.*, **1a**, 191–4 (*June*, 1949) *In German.*—The surface tension σ is calculated from a two-dimensional Debye-distribution of capillary oscillations with a maximum ν_m. A simplified model liquid is used to determine the scattering of the lattice waves in "holes." The combination with Lindemann's expression for the melting point and Rayleigh's expression for the refractive index of elastic waves yields

$$\sigma = \sqrt{(2\pi/27)(M/N)}\,\nu_m^2(V_e/V)^{4\cdot35}$$

where N is Avogadro's number, M the gram-molar mass, V the molecular volume of the liquid, V_e that of the solid. A table and graph are given. R. A. W.

532.61.08

6799. A new technique for the determination of dynamic surface tensions. POSNER, A. M. AND ALEXANDER, A. E. *Trans. Faraday Soc.*, **45**, 651–61 (*July*, 1949).—The technique for determining dynamic surface tensions described here utilizes the changes in surface potential to follow the adsorption of solute molecules upon a freshly formed surface. 3 different types of apparatus are described, a simple trough suitable for systems in which adsorption equilibrium requires a time > a few min, a Perspex channel suitable for times between 0·01 and 1 sec, and a jet suitable for times between 0·001 and 0·01 sec. Most attention has been given to the last 2 methods for obvious reasons. The hydrodynamics of the jet and channel are outlined to show how the age of the surface can be calculated from various known parameters. Methods for converting the measured surface potentials into surface tensions and surface concentrations, utilizing data from equilibrium static systems, are discussed. A number of typical results for aqueous solutions of *iso*amyl alcohol and *sec.*-octyl alcohol are presented graphically. A.

532.62

6800. The interaction between floating particles. NICOLSON, M. M. *Proc. Camb. Phil. Soc.*, **45** (*Pt* 2) 288–95 (1949).—If the surface of a liquid be not horizontal the force due to buoyancy acting on a floating bubble has then a component tangential to the surface. As the presence of a single bubble gives rise to an inclination of the surface in its neighbourhood a second bubble, when near to the first, experiences a force due to buoyancy, causing it to approach the first bubble. Under the assumption that the exposed and submerged surfaces of each bubble are spherical an expression is found which represents the curve of height of water surface against distance from the bubble. The potential energy of two similar bubbles is then calculated as a function of the dimension of the bubbles and their distance apart. The theory obtained is applicable to bubbles of diameter $\leqslant 3$ mm, and it is found that the energy-distance curve for two similar bubbles of a certain size resembles closely the corresponding curves for Kr and A gas atoms. G. G.

532.64 : 541.183.02

6801. Effect of a thin adsorbed film on the energy of adhesion between solid and liquid. BERNARD, R. AND HIRTZ, J. *C.R. Acad. Sci., Paris*, **228**, 1859–61 (*June* 13, 1949) *In French.*—Drops of tricresyl phosphate were placed on several solid surfaces and the contact angle measured at intervals over times extending to weeks. This liquid has such a low vapour pressure that evaporation can be neglected. The solid surfaces (spar, copper and quartz) were treated in various ways and it is shown that the change of contact angle with time is due to molecular interchange between the liquid of the drop and any absorbed film (often H_2O) on the solid surface. The energy of adhesion normally measured is that between liquid and the adsorbed film. J. I.

MOLECULAR THEORY OF LIQUIDS 532.7

532.7

6802. Theory of viscosity. BALÁZS, F. Letter in *Nature, Lond.*, **164**, 191–2 (*July* 30, 1949).—The calculation of viscosity from unimolecular reaction rate theory is modified by a correction due to Hirschfelder [Abstr. 1345 (1948)] which takes account of the equilibrium between molecules in the initial state and in the activated state. The viscosity calculated is 3 to 4 times that obtained from Andrade's formula. J. E. C.

532.712

6803. Tables of osmotic and activity coefficients of electrolytes in aqueous solution at 25°C. ROBINSON, R. A. AND STOKES, R. H. *Trans. Faraday Soc.*, **45**, 612–24 (*July*, 1949).

532.72

6804. Diffusion in media with variable properties. I. The effect of a variable diffusion coefficient on the rates of absorption and desorption. CRANK, J. AND HENRY, M. E. *Trans. Faraday Soc.*, **45**, 636–50 (*July*, 1949).—Numerical solutions of the diffusion equation in one dimension are obtained for a number of diffusion coeffs. varying in different ways with the concentration of the diffusing substance, in order to

see how the form of the diffusion coeff. influences the relative behaviour of the absorption and desorption-time curves. In all the cases examined it is found that, when the diffusion coeff. increases uniformly with increasing concentration, absorption is quicker than desorption throughout, but that, when the diffusion coeff. decreases with increasing concentration, the reverse is true. When the diffusion coeff. first increases, passes through a maximum value and finally decreases as concentration increases, the adsorption and desorption-time curves may cross each other and the conditions for which this occurs are examined. The accuracy of an approximation to $\int D\,dC$ is considered and on the basis of this approximation a new method of evaluating the diffusion coeff. concentration relation from experimentally determined absorption-time curves is suggested. A.

532.72 : 535.417

6805. Improvements in the interferometer method for recording vertical diffusion and sedimentation in liquids. NICOLAS, L. AND CALVET, E. *C.R. Acad. Sci., Paris*, **228**, 559–61 (*Feb.* 14, 1949) *In French.*—A modified Rayleigh interferometer is described, with one cell containing a standard liquid, and the other containing the liquid being investigated. The rate of change of concentration is deduced from the fringe shift which takes place as the optical path alters.

N. C.

532.72 : 533.15

Kinetic theory of diffusion in liquids. *See Abstr.* 6810

532.73

6806. The influence of solutes on the constitution of water. EUCKEN, A. *Nachr. Wiss. Göttingen* (*No.* 2) 33–6 (1947) *In German.*—The Tammann "coincidence pressure" as an approach to this problem is not fully satisfactory because it vanishes at infinite dilution, and it is more useful to employ such properties as the apparent molar volume or specific viscosity of solute which reach a limiting value at infinite dilution. Relations are theoretically derived for the influence of solutes on these quantities in aqueous solution taking into account hydration number and the association of water into aggregates of 1, 2, 4 and 8 molecules. To ascertain the effect of the hydration of the solute on the association equilibria of water a parameter D_n is introduced equal to $d\gamma'_n/d\gamma'_H$, where $d\gamma'_n$ is an infinitesimal change in the molar fraction of the aggregates of n water molecules ($n = 1, 2, 4$ or 8) and $d\gamma'_H$ is the molar function of water bound by hydration to the solute. It is found that $D_n = -\gamma'_n(1 + n - \Sigma n\gamma'_n/H)$ where H is the hydration number. Another parameter $D_{n,z}$ similar to D_n, but referring to the mol. fraction of solute and not of water of hydration is still useful when $H = 0$. The use of D_n and $D_{n,z}$ in calculations of the apparent molar volume and heat, and specific viscosity is discussed and it is shown that explanations of several anomalous effects result. J. O'M. B.

532.739.2

6807. A critique of the theory of solubility of non-electrolytes. HILDEBRAND, J. H. *Chem. Rev.*, **44**, 37–45 (*Feb.*, 1949).—A classification of solution types based upon deviations from ideal (zero) heat of mixing, ideal entropy of mixing due to unequal molar volumes, and excess attraction between like molecules (association) or unlike molecules (solvation) is given. Sources of error in the quantitative formulation of the effects of unequal molecular attractions and sizes are considered. A. J. M.

MECHANICS OF GASES 533

533.15

6808. The thermal separation of gases at high pressures. BECKER, E. W. AND SCHULZEFF, A. *Naturwiss.*, **35** (*No.* 7) 218–19 (1948) *In German.*—The thermal separation of various gas mixtures has been investigated from 1 to 80 atmospheres using two interconnected steel cylinders maintained at 160° and 20°C respectively. The degree of separation was determined either chemically or by a thermal conduction method to an accuracy of 0·1%. In the opinion of the authors the observed strong pressure-dependence of the thermal separation is largely independent of the Chapman–Enskog thermal diffusion effect. To test this conclusion using smaller temp. differences, further experiments with a Clusius–Dickel separation tube and a mixture of N_2 and NH_3 were made. In this case at atmospheric pressure the NH_3 was in excess in the upper cylinder whereas at 4 atms. the lower cylinder was richer in NH_3. At 1·8 atms. no separation took place. F. E. H.

533.15

6809. On the pressure- and temperature-dependence of thermal phenomena in diffusion. WALDMANN, L. *Z. Naturforsch.*, **4a**, 105–17 (*May*, 1949) *In German.*—By means of the Onsager–Meixner thermodynamics of irreversible processes the diffusion and conduction of gas mixtures are treated theoretically. Local temp. differences during diffusion give rise to the practically pressure-independent heat of diffusion and also the heat of mixing. From the known value of the second virial coefficient it may be calculated that for the diffusion of H/N at 1 atm. and 293°K the second effect is only about 1% of the first, whereas for A/CO_2 at 1 atm. and 220°K the second effect is almost double the first. This has been confirmed experimentally by measurements of stationary temp. differences in diffusing gas streams at various pressures, which enables the two effects to be separated. To determine the thermal diffusion constant (α) by this method it is necessary to work at low pressures. In this way the temp.-dependence of α has been investigated for the systems H/N; N,O/A; N/O; $N,O,A/CO_2$; C_2H_4/N,O,A, in the range 89°K to 372°K. F. E. H.

533.15 : 532.72

6810. Kinetic theory of diffusion in gases and liquids. II. General kinetic theory of liquids mixtures. YANG, L. M. *Proc. Roy. Soc. A*, **198**, 471–92 (*Sept.* 7, 1949).—The classical kinetic theory of simple liquids developed by Born and Green is generalized for liquid mixtures. Though the fundamental equations preserve many of the general features of those relating to simple liquids, emphasis is laid on certain points characteristic of a liquid

ixture. In the expansion procedure, improvement is been made in the choice of parameters; the otentials of the external force fields are taken as arameters instead of the external forces in order that rce diffusion should follow naturally. The hydro-ynamical equations for a liquid mixture follow after set of relations between the observable quantities id those defined with respect to each component in e mixture have been obtained. These equations hen compared with the corresponding ones for gas ixtures reveal the peculiarly complicated features of quid mixtures. A practical method of solution for e expanded equation of motion is discussed and neral expressions for the coefficients of ordinary ffusion and thermal diffusion and also the coeff. of scosity in a liquid mixture are given in the last ction. A.

533.5

311. Use of characteristic curves for pump speed . pressure. DUSHMAN, S. *Rev. Sci. Instrum.*,), 139 (*Feb.*, 1949).—The equation $(t_2 - t_1) = \int_{P_1}^{P_2} (1/S)d(lnP)$ is derived for the period of time $_2 - t_1$) required to exhaust a system of volume V om pressure P_1 at t_1 to P_2 at t_2. S and P denote the peed of the pump, and pressure in the system spectively, at any time t. By plotting $1/S$ against on semi-log cross-section paper, $(t_2 - t_1)$ can be lculated by determining the area under the curve. S. W.

533.51

312. Flow of gases in vacuum systems. WITTY, R. *Sci. Instrum. Phys. Ind.*, **26**, 316–19 (*Sept.*, 1949).—n attempt is made to give a standardized nomen-ature involving the use of "throughput," "con-uctance," "intrinsic speed," "operational speed" id various forms of efficiency. It is shown how the :tion of a pump can be better appreciated by garding the total fine-side pressure as made up of number of partial gas and vapour pressures. A.

533.56

313. Critical analysis of the so-called preliminary icuum pumps. The partition pump. Study on the olumetric efficiency of vacuum pumps. BACQUET, . H. *Vide*, **3**, 409–21 (*March*, 1948) *In French.*—While with the usual sliding blade types of box umps with 2 blades—Beale type—or with one ade—Cenco type—there is always the danger that is of higher pressure escapes to the low pressure de, especially after some wear has occurred in the ator, this danger is materially reduced in the partition mp here described and illustrated. At the same me dead spaces are considerably reduced. This sults in a marked increase in volumetric efficiency, ere defined as the ratio between pumping speed at a ven low pressure and at atmospheric pressure. The ew pump comprises a hollow cylinder forming the otor which is moved inside the stator by a crank aft. A single blade with grooves for the inlet and tlet sides moves inside a slit of the stator frame and pressed against the rotor by a spring. A method r measuring the volumetric efficiency is described id a graph shows comparative values of it for single-ade, single- and double-stage 2-blade box pumps, ngle- and double-stage partition pump, Hg ejector pump, and Hg vapour and oil diffusion pump. By the use of a partition pump the Hg booster pump occasionally needed between oil diffusion pump and mechanical pump may be avoided. R. N.

533.581

6814. Kovar glass seals at liquid helium temperatures. LANE, C. T. *Rev. Sci. Instrum.*, **20**, 140 (*Feb.*, 1949).

533.59

6815. A new principle in controlled vacuum leaks. BACHMAN, C. H. Note in *Rev. Sci. Instrum.*, **20**, 219–20 (*March*, 1949).—Two "pulsed-leak" devices are described: (*a*) a metal shaft having pits bored into its surface rotates in a rubber collar. Each pit takes up gas from the "pick-up" tube and carries it to the vacuum line. The leak rate may be adjusted over a 100 : 1 range by using a variable speed drive. Lubrication with oil is essential; (*b*) a leaf spring lifted by a rotating cam carries a rubber cap which opens and closes the orifice of the pick-up tube. It operates over the range 10^{-4} mm to 1 atm, and needs no lubricant. Solenoids may replace the motor drive. S. J. G.

533.59 : 771.31

High vacuum camera. *See Abstr.* 7496

533.601 : 621–85

6816. Experimental data on models of apparatus for storing wind energy in space. VEZZANI, R. *Elettrotecnica*, **35**, 488–93 (*Dec.*, 1948) *In Italian.*—The theory is developed and experimental results are given for a device consisting of two or three coaxially arranged Venturi tubes. The multiplication factor relating the aerodynamic pressure to the difference between external and internal pressure is thereby materially increased. Graphs show the relation between this factor and the Reynolds number for various air densities, between the factor and the pressure difference for various pressures and temperatures, and the ratio of the pressure difference and the external pressure relation to the wind velocity and also for various air densities. The application of the model to actual wind power plants is discussed. Some recent publications on turbulent flow in diffusor tubes are analysed. R. N. (R)

533.6.011.3

6817. A comment on F. N. Frenkiel's note "On third-order correlation and vorticity in isotropic turbulence." BATCHELOR, G. K. AND TOWNSEND, A. A. *Quart. Appl. Math.*, **7**, 120 (*April*, 1949).—Certain suggestions of Frenkiel [*Quart. Appl. Math.*, **6**, 86 (1948)] concerning experimental data in an earlier paper of Batchelor and Townsend [Abstr. 2786 (1947)] are refuted. L. S. G.

533.6.011.3 : 534.321.9

6818. The measurement of the characteristics of a rapid flow of gas by means of an ultrasonic beam. DUBOIS, G. AND KLING, R. *C.R. Acad. Sci., Paris*, **228**, 363–4 (*Jan.* 31, 1949) *In French.*—A narrow beam of plane ultrasonic waves generated at, and emitted normally to, the wall of the conduit in which the flow occurs, is examined visually by a strioscopic method based upon that due to Pohlmann [*Naturwiss.*, **23**, 511 (1935)]. The waves, preferably of frequency of the order 100 000 c/s, are generated by a Hartmann syren [*Phil. Mag.*, **11**, 926 (1931)] provided with

a parabolic mirror of short focal length capable of producing a parallel or slightly convergent beam. The deviation of the beam is observed visually and values of the velocity of flow deduced therefrom agree, in general, to within about 5% with those derived from values of the static pressure measured at the wall, in the case of velocities less than 150 m/sec. J. S. G. T.

533.6.011.31

6819. On the visualization of marginal eddy at a wing, by means of small aluminium scales in an aerodynamic windfield. BOUROT, J. M. *C.R. Acad. Sci., Paris*, **228**, 1567–9 (*May* 16, 1949) *In French.*—The aim of the investigation is to obtain more precise information regarding certain quantities in the aerodynamic field—distribution of velocities, inclination of helicoidal trajectories, angular rotation of layers—by a chronographic method. A photographic record is reproduced from which certain results are deduced regarding the distribution of velocities as a function of radial distance from the centre of the eddy. G. G.

533.6.011.311

6820. On the transition of the boundary layer into the undisturbed flow. RIEGELS, F. AND ZAAT, J. A. *Nachr. Wiss. Göttingen* (*No.* 2) 42–5 (1947) *In German.*—The velocity profile in a boundary layer may be represented in terms of a dimensionless velocity parameter $f(\eta) = \int_0^{\eta} (u/u_1)d\eta$ where u and u_1 denote the velocity at a point in the boundary layer and in the main stream respectively, and η is a dimensionless space parameter depending upon distance from the solid surface upon which the layer is formed and on the distance along this surface from its leading edge. At the solid surface $\eta = 0$, and in the transition zone between the boundary layer and the main stream $\eta \to \infty$. The differential equation satisfied by f is $f''' + ff'' + \beta(1 - f'^2) = 0$ where β is a constant. This equation has been solved numerically by Hartree [Abstr. 2389 (1937)] but the numerical solution is not very accurate for large values of η. An asymptotic solution is possible as $\eta \to \infty$. In this paper a series expansion for f for large but finite values of η is given. This bridges the gap between the numerical and the asymptotic solutions. A. SCH.

533.6.011.5

6821. Infinitely close supersonic flows. CARRIÉRE, P. *C.R. Acad. Sci., Paris*, **228**, 1632–4 (*May* 23, 1949) *In French.*—The case considered is that of perturbation of steady supersonic flow round an obstacle, and it is shown that the potential of the perturbation admits the same characteristics as the potential of the steady flow. By the use of epicycloidal co-ordinates certain characteristics of the disturbed motion are expressed in terms of co-ordinates of the steady motion. The theory allows flows to be calculated regarded as perturbations of flows already calculated, and is in harmony with the classical theory of von Kármán. G. G.

533.6.011.5 : 534.231

The sound field produced by a point source at supersonic speed. *See Abstr.* 6834

533.6.011.5 : 534

6822. The diffraction of blast. I. LIGHTHI M. J. *Proc. Roy. Soc. A*, **198**, 454–70 (*Sept.* 1949).—The behaviour of a plane shock, of a strength, travelling along a wall, when it reaches corner where the wall turns through a small angle is investigated mathematically by use of a linearia theory of anisentropic flow. At a convex corner p diffraction occurs; at a concave corner Mach reflecti The shape of the shock and the pressure distributi over the wall are calculated for a variety of sh Mach numbers from 1 to ∞. The connection, weak shocks, with acoustic theory, is displayed.

533.6.

6823. Process of measuring speed of air curre CAMBORNAC, M. *Rech. Aeronaut.*, **5**, 15–16 (*Sep Oct.*, 1948) *In French.*—The author puts forwar suggestion for a new principle of measuring velocity of an air current, eliminating errors due variations in air temp. and density. The propo method requires a sound transmitter and two sy metrically disposed sound receivers along the axis the air current. The phase differences between supply voltage at the transmitter and the volta generated at the two receivers gives a measure of speed of the air current. Suggested applicati include aerodynamic laboratory measurements a aircraft speed indicators. F.

533.6.08 : 533.6.01

6824. Non-linear theory of the hot-wire anem meter. BETCHOV, R. *Proc. K. Ned. Akad. Wet.*, (*No.* 3) 195–207 (1949) *In French.*—The behaviour a hot-wire anemometer is examined theoretica taking account of the fact that heat-transfer from wire to the ambient air is not a linear, but a quadra function of the temp. difference. In some cases effect of the quadratic term is considerable. F example, the resistance of a Pt–Ir wire of dia. and length 1·14 mm in an air-stream moving 5 m/sec is estimated to increase by 50% when current of 75 mA is passed through it; assuming he transfer to be ∝ temp. difference, an increase of 9 would be expected. Non-steady conditions caused variation in heating-current or wind speed are inve gated. It is shown that a consequence of non-lin heat-transfer is that differences in dynamic respo to variation of heating-current or wind-speed rendered less important. A. S

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534.00

6825. Description of the laboratories [Acoust Lab., Copenhagen]. INGERSLEV, F. AND NIELS A. K. *IngenVidensk. Skr.* (*No.* 2) 17–25 (1947) *Danish.*—The "dead" room is 3·7×4·15×2·4 high, the walls being covered with 19 layers (6 Hessia 13 linen) of material suspended on steel wires, of to depth 84 cm and spaced so as to produce alm complete absorption above 60 c/s. Results measurements of absorption for 40–8 000 c/s and diagram of spacings are shown. Two "hard" und

ound rooms separated by a removable wall and a nall room above (part of) serve for experiments on mping by partitions of various materials. One of e hard rooms has a removable floor. Instruments e placed in special rooms. J. A. W.

534.112

826. A note on the vibrating string. CARRIER, . F. *Quart. Appl. Math.*, **7**, 97–101 (*April*, 1949).—he results of a previous paper [Abstr. 1253 (1946)] e established in a more satisfactory manner, and a finement of the solution associated with the periodic otion of lowest frequency is obtained. L. S. G.

534.21

827. Absorption and dispersion of sound in oxygen. NÖTZEL, H. AND L. *Ann. Phys., Lpz.* (*Folge* 6) **2** (*Vos* 7–8) 393–403 (1948) *In German.*—For the equency range 0·6–4·5 kc/s the velocity of sound O contained in a tube was determined by comaring the resonant frequencies with those obtained ith the tube full of dry air free from CO_2. The sts were made at 19°c and atmospheric pressure. he resonant frequencies for the range from the ndamental up to the 12th harmonic were deterined and the bandwidths giving ½ maximum mplitude were used to compute the absorption oeffs. Absorptions were measured for pure O and) diluted with small amounts of H_2O vapour or NH_3. Definite relations were established between the requencies giving max. absorption and the H_2O nd NH_3 contents. The precise dispersion measurements agreed well with the theoretical values based n thermodynamics. A. C. W.

534.21 : 621.317.39

828. Sound-absorption coefficients measured by the ube and the space methods. INGERSLEV, F. AND NIELSEN, A. K. *IngenVidensk. Skr.* (*No.* 2) 65–72 1947) *In Danish.*—A loudspeaker at one end of the ube emits a plane wave which is reflected by a ample of the material closing the other end. Interference between incident and reflected wave causes ressure max. and min. at $\lambda/4$ intervals and measurements of the max./min. ratio yield data for calculating he absorption coeff. The apparatus, suitable for 00–2 000 c/s, is described and examples given. In he space method slabs (3 m² each) are placed in the loor and in a side and an end wall (of the "hard" oom) and the change in reverberation time is neasured. J. A. W.

534.213

829. Motion of an elastic sphere in an acoustic wave field in fluids. WOLF, A. *Geophysics*, **11**, 178–82 (*April*, 1946).—The motion is determined as a function of the elastic constants of the sphere, its adius and the frequency of the wave field. It is ound that the motion differs but little from the motion of an infinitely rigid sphere when the wavelength of transverse waves in the elastic sphere is at east as long as the circumference of the sphere. The coeff. of zero order scattering potential in the fluid is determined. A.

534.22

830. On the velocity of sound in air at low pressures. MAULARD, J. *C.R. Acad. Sci., Paris*, **229**, 25–6 (*July* 4, 1949) *In French.*—It is observed experimentally that below pressures of 15 cm of Hg the velocity of sound in air increases according to an exponential law. The velocity is constant from atmospheric pressure to 15 cm Hg, at 10 cm of Hg the velocity 1·5% higher and at 4 cm of Hg it is 4% higher than at atmospheric pressure. The measurements of velocity were made in a steel tube 2 743 cm long and 8 cm internal diameter, buried in the earth and at a depth of 50 cm to maintain constant temp. conditions. A. B. W.

534.22

6831. The acoustic field of a rapidly moving source of sound. ROTT, N. *Mitt. Inst. Aerodyn. E.T.H., Zurich.*, **9** (1945) *In German.*—Following a historical survey including Doppler's results and the fundamental acoustic equations with their solutions, discussions and formulae are presented on the acoustic field in parallel flow, on the field of a moving source of sound in an emitter-centred co-ordinate system, and on complete reflection at an infinite plane. I. A.

534.222.2

6832. Splashes from underwater explosions. KOLSKY, H., LEWIS, J. P., SAMPSON, M. T., SHEARMAN, A. C. AND SNOW, C. I. *Proc. Roy. Soc. A*, **196**, 379–401 (*April* 7, 1949).—Splashes from explosions of approx. spherical charges weighing 1 lb and 10 lb at depths up to 10 m were photographed with cine cameras at speeds of 16–2 000 frames/sec. Defining a parameter $\alpha = W^{\frac{1}{3}}/D$ where W is the charge weight (lb) and D the depth (m), it is shown that for $0{\cdot}3 < \alpha < 4{\cdot}0$, the initial velocity of rise of the water V (m/sec) is given to an accuracy of about 10% by the relation $V = 66(\alpha - 0{\cdot}1)$. The peak pressure of the shock wave sent out by the explosion was calculated from this relation; the values found were somewhat > those obtained by other workers using pressure-gauges. 3 separate phases of splash formation were distinguished, although not all of them may be observed in a particular splash. These phases are: a whitening below the water surface a few msec after detonation, which spreads at about 1 500 m/sec and does not disturb the surface (this phenomenon is termed the "crack"); a region in which the general level of the water is not altered, but surface irregularities are accentuated to form hummocks and spikelets (the "black ring"); and finally, a general rise of the surface water in the form of droplets (the "dome"). Several theories of the formation of the dome and the black ring are considered, and the phenomena associated with oscillations in the volume of the gas bubble formed by the explosion are described. A. SCH.

534.231

6833. On the energy flow in a sound field in a flowing medium. RICHTER, G. *Z. Phys.*, **125** (*Nos* 1–3) 98–107 (1948) *In German.*—The energy flow in the medium is studied from two different points of view: (1) following the course of one and the same particle of matter, (2) observing the flow across a fixed surface. The distinction between the two points of view is negligible for small motions, but important in relation to ultrasonic waves near to cavitation limit, and to explosive waves of great intensity. The theoretical results worked out are illustrated by an application to plane waves subject to Hookes' pressure law. G. G.

534.231

6834. On the sound pressures received by an observer in relative motion with reference to a point source in uniform rectilinear motion at supersonic velocity in a perfect fluid. LIÉNARD, P. *C.R. Acad. Sci., Paris*, **228**, 1108–10 (*March* 28, 1949) *In French.*—An extension of the previous Abstr. It is shown that when the source is moving at supersonic velocities the moving observer receives two distinct waves, appearing to come from opposite directions and of which the frequencies are modified by the Döppler effect. A. B. W.

534.231 : 533.6.011.5

6835. On the sound field produced by a point source in rectilinear uniform motion at supersonic speed in a perfect fluid. LIÉNARD, P. *C.R. Acad. Sci., Paris*, **228**, 910–12 (*March* 14, 1949) *In French.*—Analytical expressions and the characteristics of the sound field produced by a source at supersonic velocity are derived with reference to axes attached to the source. A. B. W.

534.232

6836. Non-stationary [acoustic] radiation of a semi-surface. KHARKEVICH, A. A. *J. Tech. Phys., USSR*, **19**, 833–8 (*July*, 1949) *In Russian.*—Mathematical. The acoustic radiation emitted by a semi-surface is analysed, particularly with regard to phenomena occurring near the edge of the semi-surface and to the reaction of the medium. F. L.

534.26

6837. Diffraction of acoustic waves in tubes of variable diameter. OSADCHENKO, A. F. *J. Tech. Phys., USSR*, **19**, 616–33 (*May*, 1949) *In Russian.*—The problem is treated for a homogeneous, infinite and non-viscous medium, as the difficulties would become insurmountable by the introduction of viscosity: curvilinear co-ordinates are employed. The eigen-functions of the problem are Bessel functions: unfortunately the equation for determining the eigen-values contains 4 new, untabulated functions. Expressions are given for the propagation constant, phase velocity and an evaluable relation for real eigen-values. B. F. K.

534.321.9

6838. The absorption of ultrasonic waves in liquids. SETTE, D. *Nuovo Cim.* (*Ser.* 9) **6** (*Suppl. No.* 1) 1–145 (1949) *In Italian.*—A comprehensive review of the subject with a complete collection of data and references. L. P.

534.321.9

6839. The absorption of ultrasonic waves by single crystals. SOKOLOV, S. YA. *Dokl. Akad. Nauk, SSSR*, **64** (*No.* 4) 503–5 (1949) *In Russian.*—The coeff. of absorption in quartz was measured by counting the number of times a pulse, generated in a small crystal, was reflected inside a larger crystal clamped to the smaller. About 7 and 52 reflections were observed for propagation perp. and parallel, respectively, to the optic axis. Faults or twinning greatly disturb regular reflection. The way in which the expression for loss in an isotropic medium should be modified is suggested. A. L. M.

534.321.9

6840. Ultrasonic velocities of sound in some liquid metals. KLEPPA, O. J. Letter in *J. Chem. Phys.*, **17**, 668 (*July*, 1949).—An electronic pulse circuit technique is used to measure sound velocities in molten Na, K, In, Sn and Hg. The velocities, their temp. coeffs., and the adiabatic and isothermal compressibilities are given. D. H. V.

534.321

6841. On the opacity to ultrasound of porous media. HOMÈS, G. A. *C.R. Acad. Sci., Paris*, **228**, 1695–7 (*May* 30, 1949) *In French.*—Describes an experimental study of the absorption of sound of 1 Mc/s frequency (*a*) in water containing a progressively changing proportion of air bubbles, and (*b*) in solid media, e.g. paraffin wax, made heterogeneous by a controlled proportion of metal balls of known diameter. Tables are given showing the variation of sound transparency as a function of the proportion of bubbles or metal spheres respectively. It is suggested that it should be possible to measure the "compacité" of a porous body by its transparency to ultrasonics. A. B. W.

534.321

6842. The absorption of ultrasonic waves in liquids. SETTE, D. *Ric. Sci.*, **19**, 52–61 (*Jan.–Feb.*, 1949) *In Italian.*—An up-to-date review. L.

534.321.

6843. Relations between heating and cavitation in media subjected to ultrasonics. DOGNON, A. AND SIMONOT, Y. *C.R. Acad. Sci., Paris*, **228**, 990–2 (*March* 21, 1949) *In French.*—Measurements made with a small thermocouple show that, in liquids in which ultrasonic waves cause cavitation, the temp. rises slowly, whilst in liquids in which cavitation does not occur, the temp. rise is very rapid. This is contrary to expectation and no explanation is offered. H. J. H.

534.321.

6844. On the propagation of supersonic waves through liquids and solutions. GHOSH, B. B. *Indian J. Phys.*, **23**, 79–87 (*Feb.*, 1949).—A survey of the position of absorption and dispersion of supersonic waves in liquids, both theoretical and experimental, has been made. Different theories, including those of the author, have been critically discussed and the theoretical expression deduced by the author has been further extended to calculate the dispersion in electrolytic solutions. It has been suggested that the experimental observations on the dispersion in H_2O and $MgSO_4$ solution might be explained on the basis of water structure and the mutual interaction of electronic atmospheres of molecules.

534.321.9 : 535.4

Diffraction of light by superposed ultrasonic waves. *See Abstr.* 6935

534.321.9 : 620.179.1

6845. A study of the anomalies of reflection and transmission which arise during the testing of metals by ultrasonics. BASTIEN, P., BLETON, J. AND DE KERVERSAU, E. *Rev. Métall.*, **46**, 277–86 (*May*, 1949) *In French.*—A Hughes ultrasonic flaw detector was used for testing metals and a number of anomalous results was obtained. For example, a forging of Ni–Cr–Mo steel, tested by the echo sounding technique at 2·5 Mc/s, gave a number of parasitic echoes masking the true echo, and these were attributed to the coarse-grained structure. In tests on another

steel, heat-treated in various ways to give various grain sizes, tests at 2·5 Mc/s gave anomalous reflections when the grain size exceeded 1 mm, but good results were obtained with smaller grain sizes. The anomalous reflections varied greatly when the transmitter and receiver were moved by minute amounts.
A. C. W. (R)

534.41

6846. Analysis of varying sounds. II. Practical applications of the new photographic method. IMAHORI, K. *J. Fac. Sci. Hokkaido. Univ.* (*Ser.* 2) **3**, 103–26 (*Sept.*, 1941) *In English.*—In a previous paper [*ibid.* (*Ser.* 2) **3** (*No.* 3) (1940)] the author describes a strobo-photographic method of sound analysis specially adapted to varying sounds such as speech and music, the analysis appearing simultaneously with the production of the sounds. The analysed sound appears in a photograph as black and white stripes at different positions according to frequency. The dispersion and resolving power of frequency and also the rapidity with which the analysis is made can be varied at will by a simple change of analysing plate. The latter replaces the revolving stroboscopic disc and stationary eye, in that it stands still whilst the film, on which the sound is recorded, moves at right angles to the axis of the analysing plate. Various forms of analysing plates (e.g. with logarithmic and square transmission characteristics) are used according to the type of sound analysis required. The method of preparing the analysing plates is described in detail. An interesting example of analysis is a shock sound—the click of a metronome or a sharp tap on a board—the spectrum of which consists of a series of broad bands.
A. B. W.

534.612 : 534.323 : 534.63

6847. Sound pressure, hearing intensity and frequency analysis of airborne sound. INGERSLEV, F. AND NIELSEN, A. K. *IngenVidensk. Skr.* (*No.* 2) 26–34 (1947) *In Danish.*—Air pressure variations occurring when a car passes close to (50 cm) a column were measured by a crystal microphone coupled through an amplifier to a c.r.o. With a car speed of 100 km/hr an excess pressure of 50 kg occurs when the front of the car meets the front of the column, followed by a pressure deficit of 100 kg about the middle position, then a renewed rise, gradually vanishing. Routine measurements of pressure and hearing intensity and frequency analysis are carried out by combined motor and bandfilter ($\frac{1}{3}$ octave) and a wave analyser, which are described. Examples of analysis of some organ-pipe tones and of noise in a canteen are given.
J. A. W.

534.7 : 612.85

Theory of the mechanics of the cochlea. *See Abstr.* 7493

534.833

6848. Sound-insulation against airborne sound. INGERSLEV, F. AND NIELSEN, A. K. *IngenVidensk. Skr.* (*No.* 2) 73–82 (1947) *In Danish.*—Wall material is tested by placing 3×3 m slabs in an opening in the partition between two ("hard") rooms. The insulation is defined as $20 \log (N_1/N_2)$, where N_1 and N_2 are the sound effect impinging on the partition from the sender room and the effect transmitted to the receiver room respectively. Measurements are made of the sound pressures p_1 and p_2, the area S of the partition and the number of absorption units A_2 in the receiver room, the insulation being then $20 \log (p_1/p_2) - 10 \log (A_2/S)$. Dependence on frequency is discussed, effects of holes and of "sound-bridges" in double walls are considered and some examples are given.
J. A. W.

534.835

6849. Damping of footstep noise. INGERSLEV, F. AND NIELSEN, A. K. *IngenVidensk. Skr.* (*No.* 2) 83–9 (1947) *In Danish.*—A noise generator consisting of 5 hammers (500 g) which are lifted and let drop 4 cm on to the floor is illustrated. It is used for testing the damping of floors of various types, specimens of which are inserted in the horizontal opening in the partition between two rooms one above the other. Experiments with a "floating" floor are described and standard requirements in Germany, England and Sweden are quoted.
J. A. W.

534.843

6850. Sound-distribution. INGERSLEV, F. AND NIELSEN, A. K. *IngenVidensk. Skr.* (*No.* 2) 58–64 (1947) *In Danish.*—Examples of measurements of sound pressure at various points of the town hall (Copenhagen) and the Theatre Royal are given and experiments on models are described.
J. A. W.

534.844.1 : 621.317.39

6851. Reverberation time. INGERSLEV, F. AND NIELSEN, A. K. *IngenVidensk. Skr.* (*No.* 2) 45–57 (1947) *In Danish.*—Curves showing optimum reverberation time as function of room volume are given. A tone generator (howler) and loudspeaker, electrodynamic microphone with amplifier and bandfilter, and a Neumann recorder are used for routine measurements. A number of examples, from various halls, churches, theatres and lecture rooms, are given and discussed.
J. A. W.

534.862.3 : 621.395.625.6

6852. Wide-track optics for variable-area recorders. SACHTLEBEN, L. T. *J. Soc. Mot. Pict. Engrs*, **52**, 89–96 (*Jan.*, 1949).—Discusses the improvements in s./n. ratio obtained by using a wide track and describes a new design of objective lens for wide-track variable-area recording which can be installed in a narrow track optical assembly. By using cylindrical lenses the ratio of the length to the width of the slit image is increased by $2{\cdot}44\times$ to make the slit image long enough to record a track 0·176 in wide. To compensate for loss of exposure due to increased track width without increase of slit area, a fine grain stock is used exposed with white light. Diagrams are given and the action described of the class A push-pull aperture slit and noise reduction shutter. Distortion at 2 db below 100% mod. is only 2·4%.
B. B. A. (R)

534.862.4 : 621.317.791

6853. Versatile measuring instrument for theatre sound service. PERKINS, C. S. AND SEELEY, E. S. *J. Soc. Mot. Pict. Engrs*, **50**, 554–61 (*June*, 1948).—Describes a multi-range meter, oscillator and decade bridge specially designed for the service engineer. The meter ($9 \times 5\frac{3}{4} \times 4$ in, weight 5 lb) incorporates a valve-voltmeter and a.c. amplifier which enables

outputs from photocells to be both read and heard. Addition of a rectifying probe enables the meter to read to several hundred Mc/s for television purposes. Superior a.c. characteristics are obtained by using Ge rectifiers. The oscillator is an RC type variable from 18 to 22 kc/s with output meter and attenuator. The bridge measures R and C and other functions. The latter two instruments fit together with the meter into a single carrying case, total weight being 35 lb.

B. B. A. (R)

534.87 : 621.395.623

6854. Electroacoustic arrangement for the automatic steering of mobile objects towards sound-sources. CRISTESCU, G. D. *Bull. Soc. Roumaine Phys.*, **47** (*No.* 84) 3–6 (1946) *In French.*—The outputs from two directional microphones at the front of the mobile object are separately amplified, rectified and arranged to act in opposition on a relay whose contacts control the steering mechanism of the object. A detailed description of a suitable type of relay is given.

G. F. H. (R)

OPTICS . RADIATION . SPECTRA 535

535.13 : 538.566

Huyghens principle for electromagnetic waves. *See Abstr.* 7164

535.214 : 621.317.382.029.6 : 621.392.26

6855. Absolute power measurement at microwave frequencies. CULLEN, A. L. Letter in *Nature, Lond.*, **163**, 403 (*March* 12, 1949).—Experiments are being made in which the power P to be measured is fed through a waveguide T-junction to a matched load. The third leg of the junction contains a movable plate: from a measurement of the force exerted on this plate, P is immediately deduced.

L. P. (R)

535.214.6

6856. Action of an intense luminous beam on particles of iron falling in air at different pressures. TAUZIN, P. *C.R. Acad. Sci., Paris*, **228**, 1216–18 (*April* 4, 1949) *In French.*—See following abstract.

535.214.6

6857. Action of an intense beam of light on metallic particles falling through the air at different pressures. TAUZIN, P. *C.R. Acad. Sci., Paris*, **228**, 1284–6 (*April* 11, 1949) *In French.*—Experiments on particles of Fe, Ni, Co, Mb, Bi, W show that some are repelled and some attracted by the light, at pressures from 1 to 76 cm of Hg. The effect varies with the light intensity. As the pressure is reduced below 1 cm, the effect disappears at different pressures for different metals.

N. C.

535.214.6

6858. Photophoresis, and the effect of solar light in producing a rotation of matter in a vacuum. EHRENHAFT, F. AND REEGER, E. *C.R. Acad. Sci., Paris*, **228**, 1708–10 (*May* 30, 1949) *In French.*—An apparatus is described for recording photographically the helical paths taken by grains of graphite of about 10^{-3} cm dia., under the influence of light in an inert gas at a pressure of 1 to 10 mm Hg.

N. C.

535.23.08 : 537.312.5

Increased sensitivity of infra-red photoconductive receivers. *See Abstr.* 7016

535.31 : 530.12

6859. Interference concept of moving optical images in the theory of relativity. RISCO, E. *C.R. Acad. Sci. Paris*, **228**, 2014–16 (*June* 27, 1949) *In French.*—Considers the existence, frequency and motion of the image of a monochromatic source moving in front of an optical system.

R. A. N.

535.31 : 535.8

6860. Geometrical optics, including diffraction and interference. FRANKE, G. *FIAT Rev. German Sci.* (1939–45) [*Off. Mil. Govt. Germany*] "*Applied Mathematics V*," 49–58 (1948) *In German.*—A bibliography (102 refs.) of papers published in Germany between 1939 and 1946. Main subjects are improved methods of calculation in lens design, conditions for minimum aberration, passage of light through non-homogeneous media, theory of microscopes and telescopes, improved types of interferometer, blooming of lenses, depth of focus and sharpness of images.

N. C.

535.312

6861. Plane and spherical waves in optical problems involving relative motion. Case of a moving mirror and a convergent beam. RISCO, M. *J. Phys. Radium*, **10**, 128–31 (*April*, 1949) *In French.*—By means of formulae expressing the frequency and angle of reflection of light incident on a plane mirror moving along the direction of its normal, it is shown that (apart from the frequency) the moving plane mirror may be replaced by a fixed hyperboloidal mirror, at which the ordinary laws of reflection apply. The source is at one focus of the hyperboloid, and the asymptotes define limiting directions outside which reflection cannot take place. This corresponds with cases where the component of the velocity of the light is $<$ the velocity of the plane mirror.

H. H. HOP.

535.317

6862. On a problem relating to the astigmatism of a refracting surface. BIOT, A. *Ann. Soc. Sci. Brux.*, **62**, 114–19 (*Dec.* 30, 1948) *In French.*—Treats astigmatism of a pencil whose principal ray is refracted aplanatically. It is shown that a spherical sagittal object surface is always imaged as a spherical surface concentric with the refracting sphere. This is not generally the case for the tangential image surface. Exact formulae are given for the astigmatism.

H. H. HOP.

535.317

6863. The diffraction theory of optical aberrations. NIENHUIS, K. AND NIJBOER, B. R. A. *Physica*, **14**, 590–608 (*Jan.*, 1949).—The general term in the expansion of third-order aberration-diffraction integrals has been evaluated giving series useful in cases where the aberration is $\gtrsim 1\lambda$. Examples are given of the light distribution in the mid-plane for a case of astigmatism for coma (in the Gaussian plane), and for spherical aberration both in the paraxial focal plane and in the plane mid-way between this and the marginal ray focus. The effect of aberration on star-images has been studied photographically using a microphotometer for the measurement of intensities. Good agreement is shown with the theoretical curves.

H. H. HOP.

535.317

6864. Erratum: A differential adjustment method of defining optical systems. STEMPEL, W. M. *J. Opt. Soc. Amer.*, **39**, 199 (*Feb.*, 1949).—See Abstr. 1373 (1949).

535.317.2

6865. Contribution to the theory of a new type of objective. SCHULTZ, H. AND TILLER, H. *Z. Wiss. Photogr.*, **43**, 183–91 (*Nos* 9–10) (1948) *In German.*—Discusses the Gaussian optics of a new class of photographic objectives. Diagrams show the construction of 3 examples (F/3·5, F = 45 mm for 24×36 mm): a fourth example has the same focus and size of field, but an aperture = F/1·5. These systems all have an exit pupil at ∞. H. H. HOP.

535.317.25 : 535.822.9

6866. Limit of resolution of phase contrast microscope. FRANÇON, M. *C.R. Acad. Sci., Paris*, **228**, 1413–14 (*May* 2, 1949) *In French.*—When the angular radius of the phase plate is $0{\cdot}3\,u$, u the aperture of the objective, n the refractive index and λ the wavelength, the resolving power is shown to be $1{\cdot}33\,\lambda/2n \sin u$. Increased resolving power is obtained by an opaque stop over the centre of the objective, provided that the illumination is sufficiently strong. N. C.

535.317.5

6867. On the geometrical aberrations of optical systems slightly off-centre. MARÉCHAL, A. *C.R. Acad. Sci., Paris*, **228**, 668–70 (*Feb.* 21, 1949) *In French.*—The classical theory of corrections up to the third order is applied to deal with spherical aberration, coma, field curvature, astigmatism and distortion. The result obtained agrees with experiment in one verified case. Corrections of higher order may become important. N. C.

535.317.9

6868. Some notes on the designing of aspherical magnifiers for binocular vision. COULMAN, C. E. AND PETRIE, G. R. Letter in *J. Opt. Soc. Amer.*, **39**, 512–13 (*July*, 1949); also *Nature, Lond.*, **164**, 586 (*Oct.* 1, 1949).—Describes requirements and (qualitatively) the results achieved, in the design of a 6 in focus 4½ in aperture binocular reading lens, having eye-relief of 5 in. A conicoidal figuring $y^2 = z(-15+10x)$ on the surface nearer the object produces left- and right-eye images which can be used with little disturbance of the normal relation between accommodation and convergence. H. H. HOP.

535.326

6869. On the variation of molecular optical anisotropy with wavelength. SERVANT, R. *C.R. Acad. Sci., Paris*, **228**, 1797–9 (*June* 8, 1949) *In French.*—Figures are given which show the variation for calcite, benzene, chlorobenzene, hexane, nitrobenzene, carbon disulphide and toluene. The variation is $\propto (n^2 - 1)$, n being the refractive index. H. G. J.

535.33

6870. Multipole radiation in atomic spectra. RUBINOWICZ, A. *Rep. Phys. Soc., Progr. Phys.*, **12**, 233–47 (1948–49).—A survey article which summarizes the more important of the recent advances in the field of atomic electromagnetic multipole radiation. Although the main stress is on the results for the optical spectrum, attention is also given to the developments in other spectral regions. There is an extensive bibliography. A. H.

535.33 : 539.153

Atomic energy levels. *See Abstr.* 7202

535.33.03

6871. Spectrophotometry of specimens of any form whatever. Description of a source of light of high, uniform brilliance. TERRIEN, J. AND DESVIGNES, F. *Revue Opt. (Théor. Instrum.)* **28**, 3–10 (*Jan.*, 1949) *In French.*—The source consists of a sheet Fe sphere, 70 mm dia., the interior of which is covered with MgO. A 36 W automobile headlamp is mounted inside the sphere, whilst opposite the lamp a hole is cut which is covered with a sheet of opal glass 2 mm thick. By means of diaphragms the size of the source can be varied up to 16 mm dia. The theory of the source is discussed, types of measurements possible indicated, and some numerical details given as to the uniformity of the source. A. H.

535.331

6872. The Zeeman effect in the arc and first spark spectrum of uranium. VAN DEN BOSCH, J. C. AND VAN DEN BERG, G. J. *Physica*, **15**, 329–50 (*May*, 1949).—New Zeeman effect measurements have been made in the spectral region of 2 500–5 300 Å. From these measurements more g-values are calc., giving a strong confirmation of the preliminary analysis of U I and U II. A.

535.332

6873. Remarks on the emission [spectrum] of dilute oxygen in an atmosphere of xenon. HERMAN, R. *C.R. Acad. Sci., Paris*, **228**, 381–3 (*Jan.* 31, 1949) *In French.*—Several continuous bands are attributed to specific collision processes between O and Xe atoms; a molecular complex XeO_2 may act as intermediary. A continuum near 2 430 Å may be due to the process $O(^3P_2) + O(^3P_2) \rightarrow O_2(X\,^3\Sigma) + h\nu$, but regular fluctuations in intensity are difficult to interpret and a possible alternative is $Xe^+(^2P_{\frac{1}{2}}) + O(^3P_2) + e \rightarrow Xe(^1S) + O(^3P_2) + h\nu$. A. G. G.

535.332

6874. Spectrum of doubly ionized iodine. KRISHNAMURTY, S. G. AND PARTHASARADHY, T. V. Letter in *Nature, Lond.*, **164**, 407 (*Sept.* 3, 1949).—A preliminary note. The intervals $6s(^4P_{\frac{1}{2}} - {}^4P_{1\frac{1}{2}})$, $6s(^2P_{\frac{1}{2}} - {}^2P_{1\frac{1}{2}})$ and $6s(^2D_{1\frac{1}{2}} - {}^2D_{2\frac{1}{2}})$ are 6 313, 11 254 and −1 609 cm^{-1}. The 2nd ionization potential of I is 32·6 V. A. G. G.

535.333

6875. Temperature radiation of titanium dioxide and zinc sulphide in the visible region of the spectrum. SINYAPKINA, G. I. *J. Exp. Theor. Phys., USSR*, **19**, 581–3 (*July*, 1949) *In Russian.*—The investigation of the radiation of TiO_2 and ZnS when heated to 900–1 000°C has shown once more that the "temp. luminescence" does not occur, and that the radiation observed is the usual thermal radiation whose anomalies are connected with anomalies in their absorption. F. L.

535.333

6876. A new band system of boron monoxide. SINGH, N. L. *Proc. Indian Acad. Sci. A*, **29**, 424–30

(*June*, 1949).—New bands accompanying the boric acid fluctuation bands are observed from a bead of moistened boric acid in a flame and from a spark between two glass tubes. They are assigned to $B^{11}O$ and the formula for heads is $\nu = 21\,030 + (1\,193{\cdot}3\,v' - 14{\cdot}3\,v'^2) - (1\,268{\cdot}8\,v'' - 9{\cdot}98\,v''^2)$. The lower state is identified with the $B^2\Sigma$ upper state of the β system. The vibrational intensity distribution is rather peculiar; a few bands are unassigned. A. G. G.

535.333 : 539.132

6877. Simplification of the calculations of intensity and polarization of vibration spectra of molecules. MAYANTS, L. S. *J. Exp. Theor. Phys., USSR*, **19**, 627–32 (*July*, 1949) *In Russian.*—Using the principle of bond additivity Wolkenstein [Abstr. 2314 (1942)] gave theoretical expressions for intensities and polarizations of vibration spectra of polyatomic molecules. These expressions are recalculated in a more compact form based on internal co-ordinates. J. J.

535.337

6878. On a spectroscopic method of measuring the velocity and temperature of a fast moving high temperature gas. BREDT, I. *C.R. Acad. Sci., Paris*, **228**, 1927–9 (*June* 20, 1949) *In French.*—Possibility of using broadening of spectral lines due to thermal agitation of gas to measure temp. of a moving high temp. source (e.g. a rocket jet) is discussed. Velocity of source could be found from observation of Doppler shift. T. S. E. T.

535.338

6879. The calibration of King's scale. RIGHINI, G. *Mem. Soc. Astr. Ital.*, **20** (*No.* 2) 141–57 (1949. Also *Ossoz. Mem. Oss. Astr. Arcetri*, **65**, 69–85 (1949) *In Italian.*—King's personal scale for the intensity of emission lines in furnace spectra is calibrated by means of the values of the number of atoms involved in the formation of the lines measured in absorption by means of a spectrophotometer. L. P.

535.338.1

6880. New lines in the subordinate series of the potassium spectrum and the probable existence of perturbations in the higher terms of the two series. DE VAUCOULEURS, A. AND GLASER, L. *C.R. Acad. Sci., Paris*, **228**, 1714–16 (*May* 30, 1949) *In French.*—New lines in the arc spectrum of K have been found, in the diffuse series $4P$–$12D$ up to $4P$–$16D$, and the sharp line $4P$–$14S$. These lines allow more precise determination of the series formula, and a good fit requires a hyperbolic term, suggesting a perturbation in the higher terms, although it is an atom having only one electron in the outer shell. A. C. M.

535.338.1

6881. Spectroscopic investigation of the arc and of the acetylene-air flame. HULDT, L. *Univ. Uppsala Acad. Diss.*, 77 *pp.* (1948) *In German.*—An attempt to determine from the measurement of the intensities of spectral lines, the physical state—i.e. the temp. and composition of the gas—in electric arcs and in acetylene-air flames. The experimental results have been worked out on the assumption that thermodynamic equilibrium is attained. The temp. of the arc has been found from the ratio of intensities of atomic lines, and that of the flame from reversal of lines. The electron pressure in both types of source has been calculated from the ratio of intensities of arc and spark lines of the same element. The partial pressures of radiating atoms have been determined from absolute intensity measurements of lines. The accuracy of the determinations has been limited by the errors of photographic photometry and partly by the inaccuracy of the necessary atomic and molecular constants. Within this limitation, the results are quite satisfactory for the arc, and the vapour-pressure of the material is about one hundredth atmosphere. The concordance is less good for the flame, and this is atrributed mainly to insufficiency or inexactness of molecular data. A. C. M.

535.338.3

6882. Wavelength changes in hydrogen- and helium-like spectra due to electromagnetic shift of ground terms. VON KEUSSLER, V. *Z. Naturforsch.*, **4a**, 158 (*May*, 1949) *In German.*—Bethe has explained the discrepancy in the wavelength measured for the line $2s^2S_{\frac{1}{2}} - 2p^2P_{3/2}$ of H from its calculated value, by the shift of the S term due to interaction between the electron and the radiation field. He gives an approximation formula for the shift for similar terms for H-like atoms of nuclear charge Z; from this the shift for the $1s^2S_{\frac{1}{2}}$ term of Li III is calculated to be 16 cm^{-1}. Edlén's measurements for the line $1s^2S_{\frac{1}{2}} - 2p^2P_{\frac{1}{2},3/2}$ in Li III give a shift of $15{\cdot}9 \pm 3{\cdot}3\ cm^{-1}$, in good agreement. This shift is important in calculating lines of atoms of the first row of the periodic talks, which have been stripped of electrons so as to be H-like. Similar considerations apply to the ground-term $Ps^2\ ^1S_0$ of the He-like atoms. A. C. M.

535.338.3

6883. Observation of the H spectrum in the near infra-red with an electronic eyepiece. DÉJARDIN, G. AND FALGON, R. *C.R. Acad. Sci., Paris*, **228**, 1857–8 (*June* 13, 1949) *In French.*—Numerous strong lines in the region 7 500 Å to 12 000 Å have been identified visually and photographically, with a conventional spectrograph fitted with an infrared image converter in the focal plane. Positions of the principal lines in the measured interval 7 400 Å to 10 400 Å agree with wavelengths published by previous workers. D. R. E.

535.338.33

6884. Isolating a single hyperfine component of the mercury line 2537 Å. COJAN, J. L. AND LENNUIER, R. *C.R. Acad. Sci., Paris*, **228**, 670–2 (*Feb.* 21, 1949) *In French.*—Owing to the large mass of the Hg atom the Doppler width at ordinary temps. is only 2 mÅ (1 mÅ $= 10^{-3}$ Å), but owing to hyperfine structure the 2 537 Å line has a width of 50 mÅ and so allows an order of interference of only 50 000. The line has 5 components, and the two due to isotopes 202 and 200 are the strongest. Light from a Hg arc cooled by compressed air is passed through a tube containing mercury at low pressure; a magnetic field of one strength is applied to the first half of the tube, and one of another strength to the second half. In this way one component only of 2 537 is allowed to pass, the others being absorbed by Zeeman components in the Hg filter. With this filtered light, interference is obtained in a Fabry–Perot interferometer with path difference of 20 cm, and the order of interference is

85 000. From the width of the rings compared with ie space between them, it is deduced that an order f 1 700 000 is attainable. A. C. M.

535.338.4

885. Combustion of aluminium in oxygen. CUEIL-ERON, J. AND SCARTAZZINI, H. *C.R. Acad. Sci., aris*, **228**, 489–90 (*Feb.* 7, 1949) *In French.*—The urner is described. The flame spectrum shows a rong continuum, bands of AlO and lines of Na nd Al. The brightness temp., in the red, varies rough the flame from 3 260 to 2 000°c near the tip; is sensitive to changes in mixture composition.

A. G. G.

535.339

886. Efficiency of double-monochromator slits. ÖSSLER, F. *Z. Phys.*, **125** (*Nos* 7–10) 427–50 (1949) *n German.*—The efficiency is examined by a geo-netrical method, in which the contributions of eometrical shape and dispersion are separated. The ffect of altering slit-width on the energy passed by a ouble-monochromator due to a line and a continuum studied, and the effect of scattered radiation is xamined. The best slit-width for accurate examina-on of lines is considered. The results obtained by his geometrical method applied to a single mono-hromator are found to agree with those obtained by alculation by Paschen and Runge. The connection ith van Cittert's apparatus-function is touched pon. A. C. M.

535.343

887. Absorption spectra and radiation field of Ho^{+++} ions in solid salts. A discussion of the spec-rum of solid Er sulphate. SEVERIN, H. *Z. Phys.*, **25** (*Nos* 7–10) 455–74 (1949) *In German.*—The bsorption spectra of Ho sulphate and Ho ethyl-ulphate were measured at the temp. of liquid air. ines of pure electronic origin have been assigned nd the coupling between $4f$ electrons and the crystal attice has been determined and is found to be less han in Er compounds. W. R. A.

535.343–14

888. On the anomalous line-shapes in the ammonia nversion spectrum at high pressures. ANDERSON, P. W. etter in *Phys. Rev.*, **75**, 1450 (*May* 1, 1949).—Discussion shows that electric field perturbations, uch as occur in collisions, lead to a shift of the nversion frequency towards zero, and narrowing of he lines. D. H. W.

535.343–14

889. Microwave rotational spectra and structures f GeH_3Cl, SiH_3Cl, and CH_3Cl. DAILEY, B. P., AYS, J. M. AND TOWNES, C. H. Letter in *Phys. ev.*, **76**, 136–7 (*July* 1, 1949).—Pure rotational spectra ue to the $J = 2 \rightarrow 3$ transition of all 10 isotopic ombinations of Ge and Cl, unreported lines corre-ponding to the $J = 1 \rightarrow 2$ transition of $^{29}SiH_3{}^{35}Cl$, $^{29}SiH_3{}^{37}Cl$, and $^{30}SiH_3{}^{35}Cl$, and the $J = 0 \rightarrow 1$ ransition of $^{13}CH_3{}^{35}Cl$ and $^{13}CH_3{}^{37}Cl$ have been bserved. Accurate rotation constants have been erived. Combined with existing data the data now ecorded enable a complete determination of the olecular structures of CH_3Cl, SiH_3Cl and GeH_3Cl o be made from microwave results. Structural arameters are given and compared with previous values derived from other sources. The H–Si–H angle is found to be 110° 57′ instead of 103° 57′.

W. R. A.

535.343.2

6890. Analysis of the spectra of crystalline europium salts. HELLWEGE, K. H. *Nachr. Wiss. Göttingen* (*No.* 2) 58–66 (1947) *In German.*—Absorption spectrum has yellow, green and blue groups at 5 780, 5 250 and 4 650 Å respectively. The yellow group occurs only in asymmetrical crystals. In biaxial crystals the green group has 3 lines, the blue has 5. In hexagonal crystals the green group has 2 lines, the blue has 1. These results are in accord with calculation. Energy levels are given for crystals of the bromate and the ethylsulphate (which are hexagonal) and the emission spectra are thus accounted for. The emission spectra of the nitrate and sulphate (which are biaxial) suggest that one of the blue lines should not be regarded as an independent line. Further experiments with higher resolving power will be required to complete the investigation. N. C.

535.343.2–31

6891. Absorption in the near ultra-violet of crystals of nickel sulphate and selanate. VULDY, G. Note in *C.R. Acad. Sci., Paris*, **228**, 1414–16 (*May* 2, 1949) *In French.*

535.343.3

6892. Infra-red absorption by homonuclear diatomic molecules. OXHOLM, M. L. AND WILLIAMS, D. Letter in *Phys. Rev.*, **76**, 151–2 (*July* 1, 1949).—The absorption spectrum of liquid air contains two bands at $4{\cdot}3\ \mu$ and $6{\cdot}4\ \mu$ which are assigned to liquid N and liquid O respectively. Possible radiative processes are discussed, but definite conclusions must await further investigation along lines which are indicated.

W. R. A.

535.343.3

6893. The application of the Beer–Lambert law to optically anisotropic systems. COMMONER, B. AND LIPKIN, D. *Science*, **110**, 41–3 (*July* 8, 1949).—The influence of the orientation of the absorbing molecules in a cell structure on the validity of the Beer–Lambert law is considered and it is shown that the quantitative relationship between the number of molecules in the light beam and the extinction depends on the degree of orientation of the optical axes of the molecules even when measurements are made with unpolarized light. In cyanine dyes the optical axis corresponding to the main absorption band of longest wavelength coincides with the largest dimension of the molecule and such molecules—with one distinctive axis—are specially considered in regard to three particular types of orientation. The validity of the Beer–Lambert law in the interpretation of microspectrophotometric measurements on the substances in cells is questioned because these substances exist as orientated aggregates of molecules and not as true solutions. W. R. A.

535.343.3–31

6894. The influence of ionization on the absorption curves of benzene derivatives. KISS, A. AND CSETNEKY, E. Note in *C.R. Acad. Sci., Paris*, **228**, 1423–4 (*May* 2, 1949) *In French.*—The effects of ionization on the ultra-violet spectrum of aniline phenol, etc., are very briefly stated. D. H. W.

535.343.31–15

6895. The significance of an absorption band at 968 cm.$^{-1}$ in the infrared spectrum of methyl isolinoleate. LEMON, H. W. AND CROSS, C. K. *Canad. J. Res. B*, **27**, 610–15 (*July*, 1949).

535.343.32

6896. The ultraviolet absorption spectra of nitric acid solutions. JONES, R. N. AND THORN, G. D. *Canad. J. Res. B*, **27**, 580–603 (*June*, 1949).—The u.v. absorption spectra of binary mixtures of HNO_3, H_2O, acetic acid, acetic anhydride, and nitrogen pentoxide have been investigated over the ranges of concentration in which the systems exhibit sufficient chemical stability. The variations in the spectra are considered in relation to the other physical properties of the systems, as reported in the literature. The u.v. spectrum of HNO_3 in the presence both of nitrogen pentoxide and water is interpreted in terms of a series of equilibria which involve the nitrate (NO_3^-) and nitronium (NO_2^+) ions and associated and non-associated neutral molecules. The specific gravities of anhydrous HNO_3 solutions, of NH_4NO_3, potassium nitrate, ammonium acetate, acetic acid at $20 \pm 0{\cdot}1°C$ and of nitrogen pentoxide at $25 \pm 0{\cdot}1°C$ are also reported. A.

535.343.32

6897. The absorption spectra of plutonium ions in aqueous solution. BETTS, R. H. AND HARVEY, B. G. *Nat. Res. Coun. Can. Publ.* (*No.* 1850) 12 *pp.* (1948).—The absorption spectra of Pu III, Pu IV and Pu VI have been investigated in solutions containing various strong acids. The Pu IV ion was found to obey Beer's Law in 3N nitric acid solution. The vibrational spectrum of the PuO_2^{++} ion has been observed in acid solutions. The presence of Pu IV and Pu V in mixtures of Pu III and Pu VI in dilute HCl has been observed. A.

535.343.32

6898. Optical studies on the structure of electrolytic solutions. CHOW, Y. K. AND HELLWEGE, K. H. *Z. Phys.*, **125** (*Nos* 1–3) 18–26 (1948) *In German.*—Spectra of aqueous solutions of Nd–Zn nitrate at 11 concentrations between 0·00176 and 0·72 g.-mols. per litre are measured and compared with the spectrum of the solid salt. There is close similarity between dilute solution and solid but stronger solutions give a different spectrum owing to perturbation effects on the absorbing Nd^{+++} ion which has the effect of setting up an equilibrium between two forms of ion. The total absorption in the crystal is < in any of the solutions and is not dependent on polarization. W. R. A.

535.343.32

6899. Solutions of salts fluid at the temperature of liquid nitrogen: spectra of solutions of rare earths. FREED, S. AND HOCHANADEL, C. J. Letter in *J. Chem. Phys.*, **17**, 664–5 (*July*, 1949).—Details are given of the preparation of the solutions. Absorption spectra were taken at the temp. of liquid N. In the case of some salts the spectra were comparable in sharpness with those obtainable from their crystals. Measurements were also made of the electrical conductances. A. H.

535.343.4

6900. Light absorption by O_2 at 2144 Å as a function of pressure between 0·2 and 130 kg/cm². HEILPERN, W. *Helv. Phys. Acta*, **22** (*No.* 2) 105–11 (1949) *In German.*—An empirical formula relating extinction coefficient of O_2 at 2 144 Å with the pressure is deduced. C. B. A.

535.343.

6901. Pressure broadening in the inversion spectrum of ammonia. MARGENAU, H. *Phys. Rev.*, **76**, 121– (*July* 1, 1949).—A formula is developed to explai the low pressure line widths observed in the inversio spectrum of NH_3 by Bleaney and Penrose. Th assumptions made are those characteristic of th statistical theory of pressure broadening. The resul which is entirely devoid of adjustable parameter agrees with the data about as well as do the impac theories with their unreasonable collision radius. A.

535.343.

6902. Frequency ν_2 in the infra-red spectrum o CH_4. BURGESS, J. S. Letter in *Phys. Rev.*, **76**, 30 (*July* 15, 1949).—The frequency ν_2 has so far not bee reported, principally because it has been overlai by a strong water band. It has now been observed a $1\,533{\cdot}6\ cm^{-1}$, using a vacuum infrared gratin spectrometer. The character of the band agree with that to be expected on the theory involvin Coriolis interaction between ν_2 and ν_4. A. C. M

535.343.4 : 537.525.

Light absorption by iodine vapour under Joshi effec *See Abstr.* 7035

535.343.4 : 539.13

6903. Anomalies in the microwave spectrum o methyl cyanide and methyl iso-cyanide. NIELSEN, H. H Letter in *Phys. Rev.*, **75**, 1961 (*June* 15, 1949).—Th microwave spectra of methyl cyanide and isocyanid both show lines originating with rotational transition in an excited vibration spectrum; these lines aris from an *l*-type doubling. W. R. A

535.343.4–1

6904. Nuclear quadrupole effects in the microwav spectrum of the asymmetric top molecule, viny chloride. GOLDSTEIN, J. H. AND BRAGG, J. K. Lette in *Phys. Rev.*, **75**, 1453–4 (*May* 1, 1949).—Transition observed near 23 000 Mc/s are identified and quad rupole coupling constants evaluated. The C–Cl bon is not axially symmetric. D. H. W

535.343.4–14 : 538.61

6905. A new method of measurement of the Zeema effect. The resonance effect with circular magneti polarization of Hertzian waves. KASTLER, A. Note i *C.R. Acad. Sci., Paris*, **228**, 1640–2 (*May* 23, 1949) *French.*—Numerical estimation shows that the rotatio of the plane of polarization of 10 cm radiatio propagated parallel to a static magnetic field shoul be easily detectable when the frequency is close to paramagnetic resonance frequency of the medium. D. H. W

535.343.4–1

6906. Excited-state bands of atmospheric CO MOHLER, O. C., MCMATH, R. R. AND GOLDBERG, L Letter in *Phys. Rev.*, **75**, 520–1 (*Feb.* 1, 1949).— Detailed examination of the atmospheric absorptio spectrum at 2·08 μ show it to be the negative branc of the $0\,1_1\,0 \rightarrow 0\,5_1\,1$ transition of CO_2. D. H. W

535.343.4–15

6907. Excited-state bands in atmospheric spectra. ADEL, A. Letter in *Phys. Rev.*, **75**, 1262 (*April* 15, 1949).—Comment on preceding Abstr.

535.343.4–15 : 539.133

6908. Erratum: The infra-red spectrum and molecular constants of $C^{12}O^{16}$ and $C^{13}O^{16}$. LAGEMANN, R. T., NIELSEN, A. H. AND DICKEY, F. P. *Phys. Rev.*, **76**, 59 (*July* 1, 1949).—See Abstr. 3135 (1947).

535.343.4–15 : 539.133

6909. The hydrogen sulphide bands at 10 200 cm^{-1}. GRADY, H. R., CROSS, P. C. AND KING, G. W. Letter in *Phys. Rev.*, **75**, 1450 (*May*, 1949).—Moments of inertia for the ground state and excited states concerned in the bands with centres at 9 911·05, 10 188·25 and 10 194·48 cm^{-1} are derived from the interpretation of the spectrum as resolved on a grating. D. H. W.

535.345.6

6910. The theory of the Christiansen experiment. RAMAN, C. V. *Proc. Indian Acad. Sci., A*, **29**, 381–90 (*June*, 1949)—The effects exhibited by a Christiansen filter can only be explained or understood in terms of wave-optics. A theoretical formula is derived for the distribution of intensity in the spectrum of the transmitted light, the variables involved being the wavelength of the light, the average size of the particles of the powder, the thickness of the cell and the difference in the refractive indices of the powder and the liquid for the wavelength under consideration. The characters of the halo observed around the light source are also discussed in terms of diffraction theory. The theory explains the facts of observation in a very simple manner and gives results in satisfactory accord with the available experimental data. A.

535.37 : 537.312.5

Absence of photoconductivity in tungstate phosphors. *See Abstr.* 7018

535.37 : 620.18/.19

6911. Luminescent methods of defectoscopy and the metal-cutting industry. LAUSHKINA, M. M. AND ROGOV, F. I. *Izv. Akad. Nauk, SSSR, Ser. Fiz.*, **13** (*No.* 2) 251–3 (1949) *In Russian.*

535.371

6912. Alkaline earth halophosphates and related phosphors. JENKINS, H. G., MCKEAG, A. H. AND RANBY, P. W. *J. Electrochem. Soc.*, **96**, 1–12 (*July*, 1949).—New alkaline earth halophosphates activated with Sb and Mn enable white light to be obtained in fluorescent lamps from a single chemical compound. Luminescent properties are discussed as a function of composition and several possible substitutions. The latter include substitution of Sr or Ba for Ca, of Cl or OH ion for F, of several primary activators in place of Sb, and of other activators in place of Mn in hydroxyapatites. A short account of the structure of the phosphors is presented. The mechanism of luminescence in these phosphors and some of their performance characteristics are discussed briefly. A.

535.371

6913. Luminescence of NaCl–Ni, NaCl–Cu and NaCl–Ag phosphors excited by X-rays. PARFIANOVICH, I. A. *J. Exp. Theor. Phys., USSR*, **19**, 605–14 (*July*, 1949) *In Russian.*—The investigation of the luminescence of NaCl–Ni, NaCl–Cu and NaCl–Ag phosphors excited by X-rays shows that the luminescence spectrum of each of the above phosphors consists of a bright band characteristic of the given activator. From the number and location of maxima in the temp. luminescence curves of phosphors excited at room temp. and at $T = 150°K$, the number of the systems of local levels has been determined and their depth calculated. It has been established that, in excited phosphors, the distribution of electrons among the various systems of local levels depends on the activator and on the temp. of the phosphor during excitation. Detailed investigation has been carried out of the properties of the most stable centres storing the energy for phosphorescence in NaCl–Ni. F. L.

535.371

6914. A study of the initial stages of excitation and extinction of ZnS phosphors with an oscillographic phosphoroscope. ARKHANGELSKAYA, V. A., BONCH-BRUEVICH, A. M., TOLSTOI, N. A. AND FEOFILOV, P. P. *Dokl. Akad. Nauk, SSSR*, **64** (*No.* 2) 187–90 (1949) *In Russian.*

535.371

6915. The electron trap mechanism of luminescence in sulphide and silicate phosphors. JOHNSON, J. S. AND WILLIAMS, F. E. Letter in *Proc. Phys. Soc., Lond. A*, **62**, 317–19 (*May*, 1949).—Comparison of the thermoluminescence data for ZnS . Cu of Garlick and Gibson [Abstr. 2433 (1948)] with those of Williams and Eyring [Abstr. 2106 (1947)]. Differences are attributed solely to different heating rates. A reply by Garlick disputes this. S. T. H.

535.371

6916. Crystals of luminescent ZnF_2 . Mn. JOHNSON, P. D. AND WILLIAMS, F. E. Letter in *J. Chem. Phys.*, **17**, 583–4 (*June*, 1949).—Clear crystals have been prepared by the simple method of controlled cooling of the luminophor melted in a Pt crucible, the gas supply being gradually decreased. J. E.

535.371.07 : 621.327.4.032.7

6917. Design of fluorescent lamp phosphors. BUTLER, K. H. *Illum. Engng, N.Y.*, **44**, 267–76 (*May*, 1949).—Discusses the colour requirements of modern fluorescent lamps, the spectral distribution of powders in common use and means of evaluating and stating the colour of lamps graphically. Spectral distributions of tungstate, silicate and halophosphate luminophors are given. J. E. (R)

535.372

6918. Influence of pressure on the phosphorescence spectrum of the helium molecule. HERMAN, L. *C.R. Acad. Sci., Paris*, **228**, 2016–18 (*June* 27, 1949) *In French.*

535.372

6919. New method of investigating absorption spectra of crystal phosphors. BRUMBERG, E. M. AND PEKERMAN, F. M. *Izv. Akad. Nauk, SSSR, Ser. Fiz.*, **13** (*No.* 2) 218–23 (1949) *In Russian.*—A new method of photographing absorption spectra of single crystals of small-crystal (powder) phosphors has been developed and applied to ZnS, ZnS–Cu, ZnS . CdS and ZnS–Mn phosphors within the range 405–254 mμ. The method enables the investigator to obtain spectrograms free from diffuse scattering and to carry out the investigation in the remoter u.v. F. L.

535.372

6920. Luminescence of silver halides at low temperatures. FARNELL, G. C., HALLAMA, R. AND BURTON, P. C. Letter in *Nature, Lond.*, **164**, 146–7 (*July* 23, 1949).—At 85°K AgCl gives a strong blue-green fluorescence, attributed to the pure crystal; AgBr an orange-red, ascribed to Ag; and AgI a blue-violet. Mixed crystals of Bromo-iodide give a green band, attributed to the iodide ion. J. E.

535.375.5

6921. On the translational frequencies in the scattering spectra of molecular crystals and the spectrum of *d*-tartaric acid. RASKIN, SH. SH. AND SKRIPOV, F. I. *Dokl. Akad. Nauk, SSSR*, **64** (*No.* 3) 317–20 (1949) *In Russian.*—The scattering spectrum of *d*-tartaric acid was examined experimentally. Extra lines, of the order of translational frequencies calculated from elastic constants, were found. It is tentatively concluded that in the spectra of molecular crystals translational frequencies may appear and that for organic crystals intermolecular oscillations are not necessarily confined to the range below 120 cm^{-1}. A. L. M.

535.375.5

6922. Raman spectrum of the acid fluoride of potassium and structure of the FHF ion. COUTURE, L. AND MATHIEU, J-P. *C.R. Acad. Sci., Paris*, **228**, 555–7 (*Feb.* 14, 1949) *In French.*—Plates were grown sufficiently large for transverse scattering in the Raman effect. Assuming a linear form for the FHF ion, only one internal frequency of vibration should appear in the Raman effect. Actually 2 lines appear, at 595 and 604 cm^{-1}, both polarized; the former is considerably the stronger, which does not fit in with a resonance explanation of the doubling. An explanation is sought in the fact that there are 2 ions in the translational unit cell. A. C. M.

535.375.5

6923. Experimental study of the polarization of Raman lines of sodium thiosulphate in aqueous solution and crystallized. VASSAS-DUBUISSON, C. *C.R. Acad. Sci., Paris*, **228**, 1712–14 (*May* 30, 1949) *In French.*—The frequencies, relative intensities, and depolarizations are reported for the Raman lines scattered by a single crystal of sodium thiosulphate, for different orientations. The frequencies are separated into vibrations in, or perpendicular to, the plane of symmetry. The Raman spectrum of the aqueous solution is also measured, and a doubt is expressed concerning the ternary symmetry attributed to the S_2O_3 ion. A. C. M.

535.375.5

6924. Low-frequency Raman spectrum of anthracene. FRÜHLING, A. *C.R. Acad. Sci., Paris*, **229**, 33–5 (*July* 4, 1949) *In French.*—Low-frequency Raman lines are observed for a single crystal of anthracene at 48, 68 and 120 cm^{-1}. These are shown to be consistent with rotational vibrations about the principal axes of the molecule. The restoring forces concerned are larger than those found for other aromatic hydrocarbons. A. C. M.

535.375.5

6925. Variation of Raman spectra with concentration in aqueous solutions of nitrates. MATHIEU, J-P. AND LOUNSBURY, M. *C.R. Acad. Sci., Paris*, **229**, 295–(*July* 25, 1949) *In French.*—Raman spectra a observed of 17 different nitrates in solutions varyin in concentration from one gram-equivalent per lit up to saturation, and sometimes beyond. Frequencie depolarizations, and relative intensities of the lin are measured. For low concentrations only are th lines observed consistent with an equilateral triang structure of NO_3 ion. The first effect of increase concentration is to cause the line at about 1 380 cm to split into 2, showing a lowering of symmetry the NO_3. For certain polyvalent nitrates (e.g. Ca as the concentration increases, all the lines becom accompanied by others. It is thought that there a 2 distinct states of the NO_3 ion, the new lines bein attributable to the second state. Addition of othe salts acts in the same direction as increase of concen tration. A. C. M

535.3

6926. Determination of refractive indices an thicknesses of thin films. ABELÈS, F. *C.R. Aca Sci., Paris*, **228**, 553–5 (*Feb.* 14, 1949) *In French.*— Refractive indices are found by coating part of th glass surface with the film, then determining experi mentally the angle of incidence for which the reflectio factor of the film is equal to that of the glass, whe the incident light is plane polarized with its electr vector in the plane of the surface. It follows that th light is incident on the film at the polarizing angl whose tangent is the refractive index. The thickne is deduced from the state of polarization of th reflected light. N. C

535.3

6927. Reflecting factors of thin films of differen metals when on transparent supports. ROUARD, P AND COTTON, P. *C.R. Acad. Sci., Paris*, **228**, 1706– (*May* 30, 1949) *In French.*—Thin films of Pt, Al, Be Zn and Mg have min. reflecting power for all visibl wavelengths at the same thickness. Ag and Au d not behave in this way. N. C

535.3

6928. On the reflection factors of very thin films platinum deposited on glass. ROUARD, P. *C.R. Acad Sci., Paris*, **228**, 1639–40 (*May* 23, 1949) *In French.*— Gives experimentally obtained results for thicknesse up to 75 Å for light of wavelengths 4 358 Å, 5 461 and 5 780 Å. Agreement with calculation is not good thus indicating that thin films of Pt have a differen structure from the metal in bulk. N. C

535.3

6929. Single or multiple thin layers. ABELÈS, F *Rev. Opt. (Théor. Instrum.)* **28**, 11–31 (*Jan.*, 1949 *In French.*—A review of theoretical studies on th modification caused, in reflection by a transmissio through a surface between two different optical media by thin layers deposited at the surface. Special case are treated in detail of absorbing layers on a trans parent base, and transparent layers on an absorbin base, and finally multiple transparent layers on transparent base. Various applications are con sidered, such as interference filters and polarizatio devices. Theoretical expectations are compare with experimental results. A. C. M

535.39

6930. On the reflection, transmission and absorption factors of thin metallic films. ROUARD, P. *J. Phys. Radium*, **10**, 120–7 (*April*, 1949) *In French.*—A review of present knowledge and its applications to the increasing or decreasing of the reflection from a surface by coating with a metallic film. The two reflection coeffs. and the transmission of a metallic film on a supporting face may be found as a function of film thickness from the refractive index and coeff. of extinction of the metal. A convenient graphical method of solution (due to Perrot, Cotton) is described by means of an example. Curves are given showing the dependence of the reflection coeff., the transmission and absorption of metal films on thickness in typical cases. H. H. HOP.

535.412

6931. Interference of light diffracted by the edges of a Lummer–Gehrcke plate. CHARRON, E. AND JÉGAND, N. *C.R. Acad. Sci., Paris*, **228**, 1411–12 (*May* 2, 1949) *In French.*—The customary Lummer fringes were obtained on one side or the other of the plate. In addition a third set of fringes were observable between these, due to light from *both* sides of the plate. They were seen only in monochromatic light, and could be got with an extended source. They were fugitive. These peculiarities are due to the very long path difference involved (about 16 500 λ), and the influence of small changes of temp. Effectively only a narrow part of the source is used at any one time, so that the actual extension of the source is without ill-effect. A. C. M.

535.42

6932. On the transmission coefficient of a circular aperture. BOUWKAMP, C. J. Letter in *Phys. Rev.*, **75**, 1608 (*May* 15, 1949).—Discusses corrections to earlier expressions, given by the author, and by Levine and Schwinger [Abstr. 1842 (1949)] for the transmission coeff. of a circular aperture in an infinite plane screen in the case of a normally incident plane scalar wave.

535.42

6933. On the transmission coefficient of a circular aperture. LEVINE, H. AND SCHWINGER, J. Letter in *Phys. Rev.*, **75**, 1608 (*May* 15, 1949).—See preceding Abstr. After correction of a small numerical error, the authors' results agree with those of Bouwkamp.

535.42

6934. An asymptotic treatment of diffraction problems. VAN KAMPEN, N. G. *Physica*, **14**, 575–89 (*Jan.*, 1949).—It is shown that the disturbance at a point M near to the focus of a wave ϕ depends upon the existence of "critical points" in the case of large phase-differences. These points are of 3 kinds: first-kind points Q are such that QM is normal to the wave front at Q; second-kind points are points on the boundary for which $\partial f/\partial s = 0$, where f = phase function and s denotes the boundary; third-kind points are points of discontinuity in the boundary. Asymptotic formulae for the effects of each kind of critical point are obtained. The theory is applied to the discussion of the effects of third-order aberration. H. H. HOP.

535.42 : 534.321.9

6935. Diffraction of light by superposed ultrasonic waves. RAO, B. R. *Proc. Indian Acad. Sci. A*, **29**, 16–27 (*Jan.*, 1949).—It is shown that in the case where k, the ratio of the wavelengths of the superposed wave-trains, is even there will always be asymmetry in the diffraction pattern. The type of asymmetry is dependent upon the phase-difference Δ. The case $k = 2$ has been evaluated, using the simplified theory of Raman and Nath, for $\Delta = 0$, π and $\pi/2$. Photographs are given of radio waves diffracted by an ultrasonic wave and its octave. These confirm the theory qualitatively. In the case where k is odd there is always symmetry in the diffraction pattern. H. H. HOP.

535.421 : 534.321.9

6936. On the phenomenon of the periodical exchange between the phase-lattice and the amplitude-lattice in the Fresnel's diffraction phenomenon by gratings. Theoretical considerations and an experiment by the ultrasonic wave. NOMOTO, O. *J. Phys. Soc. Japan*, **2**, 41–6 (*May–June*, 1947) *In English.*—Treats the disturbance in planes parallel to a diffraction grating, which results when a plane wave falls normally on the grating. At certain periodic distances, the disturbance takes the form of a "corrugated" wave-front. On crossing these critical planes the bright and dark lines in the pattern interchange. Using ultrasonic waves, experiments have been performed which confirm the computed distributions of amplitude and phase. H. H. HOP.

535.43

6937. Light diffracted by lack of homogeneity (threads) in optical instruments. FRANÇON, M. *C.R. Acad. Sci., Paris*, **229**, 293–4 (*July* 25, 1949) *In French.*—"Threads" are sections of the glass, of considerable length and diameter < 1 mm, whose refractive index differs by some units in the fourth decimal place from the bulk of the glass. It is shown that this effect is not serious if the optical path difference introduced by the thread $< \lambda/4$. N. C.

535.435

6938. Temperature coefficient and spectral variation of the depolarization factor of Rayleigh scattering in liquid benzene. DE VAUCOULEURS, G. Note in *C.R. Acad. Sci., Paris*, **228**, 914–16 (*March* 14, 1949) *In French.*

535.435

6939. The effect of electric field on the degree of depolarisation of light scattering in colloidal solutions. SUBRAMANYA, R. AND NARAYANA RAO, M. R. *Proc. Indian Acad. Sci. A*, **29**, 442–57 (*June*, 1949).—The variation of ρ_u, ρ_v and ρ_h under the influence of electric field has been investigated using the following colloidal systems: (1) graphite, (2) stearic acid, (3) vanadium pentoxide, (4) benzopurpurine. The variations of ρ_u, ρ_v and ρ_h are studied using the electric field (1) perpendicular to the incident beam and the direction of observation, (2) perpendicular to the incident beam but parallel to the direction of observation, and (3) parallel to the incident beam and perpendicular to the direction of observation. Th variation in the depolarization factors depends upon (*a*) the voltage applied, (*b*) the direction of the field,

(*c*) the concentration of the solution employed. The effect of the electric field on the variations in intensity of V_v, H_v, V_h and H_h have been carried out using the double double-image prism method. The relationship between the anisotropy of the colloidal particles and the influence of the electric field on the depolarization factors, is discussed. A.

535.435

6940. Rayleigh scattering constants in liquids. DE VAUCOULEURS, G. *C.R. Acad. Sci., Paris*, **229**, 35–7 (*July* 4, 1949) *In French.*—Inadequacies of the existing theory of Rayleigh scattering are considered and modifications are advanced. W. R. A.

535.436

6941. On the depolarization of light scattered by gases. DE VAUCOULEURS, G. Note in *C.R. Acad. Sci., Paris*, **228**, 1416–17 (*May* 2, 1949) *In French.*—Comments on the lack of consistency between measurements of different authors.

535.55 : 517.94

Liebmann's formula: a complement to the optical determination of stresses. *See Abstr.* 6682

535.825

6942. A unit-magnification optical system for the attainment of long working distances in microscopy. DYSON, J. *Proc. Phys. Soc., Lond. B*, **62**, 565–75 (*Sept.*, 1949).—To fill an application for a microscope with a long working distance, several optical systems are reviewed. Of these, a system giving unit magnification to be used in conjunction with a conventional microscope is selected as suitable. This consists of a spherical mirror used with the object near its centre of curvature. The aberrations of such a system are discussed and means of correcting them described. Modifications necessary to enable vertical illumination to be used are also described, and photographs taken by means of an experimental system are shown. Other applications of the same system are suggested and designs given for a miniature system capable of being used on an ordinary microscope for an immersion objective for "nuclear plate" work and for a water immersion system for biological applications. A.

535.88 : 621.397.3

6943. Plastic lenses in television projection. STARKIE, D. *J. Televis. Soc.*, **5**, 86–92 (1947–48).—After explaining the suitability of a Schmidt optical system for television projection purposes, the ICI process of moulding the optical components from polymethyl-methacrylate and polystyrene is described. The lenses are moulded and annealed in a liquid bath, cooled under control and then submitted to a surface finishing process by means of an added thin film of polymer, filling the minute gap after shrinkage. The moulds for the latter process are of glass to allow light polymerization. The problems of assembly into a complete projection apparatus are discussed, and special directional screens of lenticular type giving horizontal wide angle viewing range are described. A. L. (R)

535.88 : 621.397.6

6944. Optical problems in large-screen television. MALOFF, I. G. *J. Soc. Mot. Pict. Engrs*, **51**, 30–6 (*July*, 1948).—A short survey of the RCA auditorium projection system (7 in c.r.t., operated at 50 kV into a Schmidt optical system with a 21 in mirror and 14½ in aspherical correcting lens), giving a 6×8 ft picture, and of the larger theatre type system (15 in c.r.t. at 80 kV and a Schmidt system with a 42 in mirror and 30 in aspherical correcting lens) for a screen of 18×24 ft. The latter optical system is the largest Schmidt projector in existence. A. L. (R)

535.89 : 621.32

6945. Spectral characteristics of light sources. MACBETH, N. AND NICKERSON, D. *J. Soc. Mot. Pict. Engrs*, **52**, 157–83 (*Feb.*, 1949).—Colour temperature as used in U.S.A., defines the colour of a source which approximately matches a black body, but does not indicate its spectral composition. The authors describe the spectral distribution of a number of sources, particularly those of special importance for cinema studios, viz. the carbon arc, the Hg–Cd lamp and the concentrated Zr arc lamp now being developed. This gives approx. black-body distribution at 3 200°K with an efficiency of 1·8 candles/W and a brightness of about 50 candles/mm². J. W. T. W. (R)

HEAT 536

536.2

6946. Generalized integral expression for the thermal boundary layer and its use for calculating heat exchange. KUDRYASHEV, L. I. *Dokl. Akad. Nauk, SSSR*, **63** (*No.* 1) 23–6 (1948) *In Russian.*—The conception of the thermal boundary layer is due to Kruzhilin [*J. Tech. Phys.*, **6** (*No.* 3) (1936)]. Applying Golubev's method [*Z. angew. Math. Mech.*, **1**, 232 (1921)] to it leads to the first form of generalized relations, integration by parts of which yields the second form of the integral relation, valid for any positive index k of the argument t^{k+1}; the substitution $k = 0$ yielding the equilibrium relation of the thermal boundary layer. The special case of stationary heat exchange leads to a formula already used by Kruzhilin and Schwab [*J. Tech. Phys.*, **6** (*No.* 7) (1937)]. The formula, after a further transformation, may now be applied to concrete problems of heat exchange between a liquid flow and a profile washed by it. Some hints for practical application are given and it is shown that the ensuing relation between Nusselt, Prandtl and Reynolds numbers very nearly coincides with one found by Pohlhausen [*Z. angew. Math. Mech.*, **1**, 115 (1921)]. B. F. K.

536.21

6947. Heat transfer in beds of fluidized solids. JOLLEY, L. J. *Fuel*, **28**, 114–15 (*May*, 1949).—Experimental data are given for the heat transfer rates to cylindrical surfaces in beds of small coke particles fluidized with air. Experiments are described first for high bed temp. (800–1 000°c) maintained by the combustion of the coke particles, and, secondly, for a bed at room temp. when radiative heat transfer is not involved. It is shown that the non-radiative heat transfer is $\geqslant$ that arising from either the fluidizing air flow or the thermal conductivity of the static bed. The measured heat transfer rates at high temps. $\sim$ the sum of (1) the calculated radiative heat

transfer rate and (2) the measured non-radiative heat transfer rate extrapolated to the high temps. W. H. D.

536.212

6948. On the convergence of the Kroll method. UMEDA, K. AND TOYA, T. *J. Fac. Sci. Hokkaido Univ.* (*Ser.* 2) **3**, 257–64 (*March*, 1949) *In English.*—Solving directly Kroll's set of equations, the nature of the solution of Bloch's integral equation has been investigated. It is a slowly varying and nearly even function. [See Abstr. 6949 (1949)]. A.

536.212

6949. Kroll's expression for the heat resistance of the monovalent metals. UMEDA, K. AND YAMAMOTO, T. *J. Fac. Sci. Hokkaido Univ.* (*Ser.* 2) **3**, 249–54 (*March*, 1949) *In English.*—The third approximation of Kroll's expression for the ideal heat resistance of the monovalent metals, which is considered to be a practically sufficient approximation, has been explicitly calculated. It has a max. at an intermediate temp., so that this max. is not likely ascribed to the insufficient order of approximation, as hitherto stated. A.

536.212 : 621.315.2

6950. The heating of a non-homogeneous rod and the charging of a non-uniform Thomson cable. SCHUNACK, J. *Arch. elekt. Übertragung*, **2**, 190–207 (*April–May*, 1948) *In German.*—The subsequent rise in temp. of an anode on which a beam of electrons of constant current strength is suddenly allowed to impinge (at time $t = 0$), and then maintained, is investigated theoretically. The anode can be considered as a rod. The differential equations for the thermal conduction are solved by the use of the Laplace transform. For an infinitely long rod the temp. at the impinging surface ($x = 0$) is $\propto \sqrt{t}$, and the temp. at any other point x measured along the rod can be obtained by multiplying the temp. at $x = 0$ by a factor which is a function of t, x and a constant depending on the rod material. For a rod of finite length the temp. wave suffers reflection at the end of the rod, and the temp. at $x = 0$ increases more rapidly than $\sqrt{t}$, becoming $\propto t$. The problem is the same as that of propagation along a Thomson-cable (self-inductance and leakance zero) fed with constant current from a source of infinitely high resistance. The correspondence between the two problems is shown in a table, and the solution for the behaviour in a non-uniform cable is applied to the corresponding case of thermal conduction in a non-homogeneous rod, such as a composite X-ray tube anode, consisting of a layer of W on Cu. As examples, rods of W, Cu, graphite, Al and Fe are considered, and graphs given of the temp. rise at $x = 0$ for infinitely long homogeneous bars of the different materials, and of the temp. rise at $x = 0$ and at the interface for a composite bar of W and Cu. S. W. (R)

536.23 : 533.16

6951. A dynamical method for the determination of the thermal conductivity of poor conductors. MERLIN, M. *Nuovo Cim.*, **6** (*Ser.* 9) (*No.* 4) 283–9 (1949) *In Italian, English Summary.*—A Fitch [Abstr. 4619 (1935)] type of apparatus is described suitable for laminar samples of thermal resistance per unit section of 800–10 000 c.g.s. and which gives results sufficiently precise for technical purposes within a few min. Experiments performed to test the limits of validity of the method are described. S. W.

536.212.3

6952. Thermal conductivity of carbon dioxide and the relation between thermal conductivity and viscosity. BOROVIK, E. *J. Exp. Theor. Phys., USSR*, **19**, 561–4 (*July*, 1949) *In Russian.*—The convection corrections for the measurements of the thermal conductivity of CO_2 have been calculated. The corrected values of the thermal conductivity of CO_2 increase with density. The thermal conductivity/viscosity ratio increases together with density for density values $<$ the critical density, and decreases with the increase of density for values $>$ the critical density. The formula $\lambda = (C_v + 9/4R)\eta/M$ suggested previously [*ibid.*, **17**, 328 (1947)] for the relationship between the thermal conductivity and viscosity is applicable for CO_2 up to the density value $= 0{\cdot}8\rho_c$. F. L.

536.244

6953. Heat transfer to wet surfaces. RÖSSLER, F. *Naturwiss.*, **35** (*No.* 7) 219–20 (1948) *In German.*—Two cases of heat transfer from the air to wet surfaces are considered: (*a*) where the thermal capacity of the body to which heat is transferred is small; (*b*) transfer to a body of large thermal capacity. In the first case the heat transfer may be written $Q = \beta(T_\infty - T_w)$, where T_∞ is the final temp. of the surface, T_w that at any time and β a factor depending upon the rate of variation of saturation pressure and the air pressure. In the second case the equation is $Q = \gamma(T_a - T_\infty)$ where T_∞ is now the final air temp. and T_a that of the air at any time and γ a factor depending upon the humidity of the air and its pressure. The forms of β and γ are thus very different. Applications of both equations are indicated. F. E. H.

536.413

6954. Approximate formula for expansion of silicate glasses. DANZIN, A. *C.R. Acad. Sci., Paris*, **228**, 561–3 (*Feb.* 14, 1949) *In French.*—An empirical formula is given in which the expansion coeff. is the sum of separate terms, each $\propto$ the content of the particular metallic oxide present. The agreement is good for thoroughly annealed glasses. N. C.

536.421.4

6955. Condensation processes at low temperatures, and the production of new sublimation nuclei by the splintering of ice. BREWER, A. W. AND PALMER, H. P. Letter in *Nature, Lond.*, **164**, 312–13 (*Aug.* 20, 1949).—The difference in experimental techniques used by Cwilong [Abstr. 2273 (1947)] and Fournier d'Albe [Abstr. 3930 (1949)] is pointed out. Cwilong's work has been repeated, and it was noticed that when the water on the walls froze ice particles fell from the walls with the subsequent presence of condensation nuclei in the cooled chamber. Without free water on the walls the effect disappeared. The expansion ratios and supersaturations at different temps. are given. It is pointed out that Findeisen's work [*Met. Z.*, **57**, 201 (1940); **60**, 145 (1943)] and the author's results suggest that the production of ice crystals by splintering, from a growing snow flake or hailstone, may be

of importance in increasing the number of ice particles in a cloud, permitting a water cloud to change into an ice cloud even if the initial number of ice-forming nuclei is inadequate. S. W.

536.423

6956. Nuclei in evaporation and condensation. RODEBUSH, W. H. *Chem. Rev.*, **44**, 269–76 (*April*, 1949).—The effect of dissolved O gas on the properties of water is briefly discussed. A thermodynamic treatment is given of the condensation of water vapour in terms of aggregates of water molecules. An aggregate containing such a small number of molecules that its behaviour is statistical and thus dependent on concentration is called a "cluster," and containing enough molecules to be uniquely determined, in vapour at a given temp. and pressure, independently of the number of aggregates per volume, a "drop." A drop is shown to determine an equilibrium saturation pressure and thus not be a nucleus. The gradual transition from cluster to drop is at $\sim 10^{-7}$ radius (133 molecules). The liquid entropy curve is shown to have a minimum there, and justification for the existence and location of this minimum is given both from theory and from the experimental behaviour of the supersaturated vapour. S. W.

536.423.4 : 537.565

6957. Condensation nuclei from hot platinum: size, coagulation coefficient and charge-distribution. NOLAN, P. J. AND KENNAN, E. L. *Proc. Roy. Irish Acad.*, **52 A** (*No.* 13) 171–90 (*July*, 1949).—The results of experiments made with a Nolan and Guerrini diffusion apparatus [see Abstr. 560 (1936)] and one photoelectric counter, to determine the relations between the size of nuclei, as deduced from the diffusion coeff., D, the coagulation coeff., γ, and the distribution of charges among the nuclei, are described. Atmospheric nuclei, and nuclei emitted by a Bunsen flame, and by heated nichrome and Pt wires, were used. Values of D measured ranged from 800×10^{-6} to $0{\cdot}7\times10^{-6}$ cm^2 sec^{-1} corresponding to radii, r, of $0{\cdot}4\times10^{-6}$ to 22×10^{-6} cm. With due allowance for heterogeneity, the results are in agreement with Smoluchowski's formula $\gamma = 8\pi rD$, and on applying the Whipple formula to the results of the variation of charge-distribution with size considerable support was obtained for Harper's relation between r and the combination coeff. with small ions. Charge-distribution results for the larger nuclei are interpreted in terms of multiple-charging. The apparent density of the nuclei was determined by simultaneous measurements of the rate of fall and of D, and evidence was obtained that the density of nuclei from hot Pt was $<$ that of atmospheric nuclei. There were indications that r at the instant of emission from hot Pt was independent of the temp., and was of the order of 10^{-7} cm. S. W.

536.44

6958. Solubility measurement in the critical region. BOOTH, H. S. AND BIDWELL, R. M. *Chem. Rev.*, **44**, 477–513 (*June*, 1949).—A review which includes an historical summary, and discussions of the nature of the critical state, geological and engineering significance, experimental methods, systems reported in the literature, and general conclusions. W. R. A.

536.46

6959. The effect of diffusion of the main reactants on flame speeds in gases. CORNER, J. *Proc. Roy. Soc. A*, **198**, 388–405 (*Aug.* 7, 1949).—The general equations of a single-reaction flame are written down, allowing for the diffusion of the main reactants and products. It is shown that the pressure-dependence of the flame speed is not altered by the consideration of diffusion. A method of successive approximation is applied to the equations with diffusion, giving an easily applied solution for the speed of a flame maintained by a single reaction whose rate depends only on the temp. and the concentrations of the reactants. A

536.46

6960. Colour changes induced in molybdenum and tungsten oxides under flame impact. ARTHUR, J. R. Letter in *Nature, Lond.*, **164**, 537–8 (*Sept.* 24, 1949).—Blueing of MoO_3 and WO_3 by edges of flames is attributed to reduction by free H atoms. Effect is strong with H flames, moderate with coal-gas, and slight with CO. Results are compared with cando-luminescence of activated CaO. A. G. G.

536.46

6961. Effect of pressure on velocity of burning. LINNETT, J. W. AND WHEATLEY, P. J.; GAYDON, A. G. AND WOLFHARD, H. G. Letters in *Nature, Lond.*, **164**, 403–4 (*Sept.* 3, 1949).—Results are given for ethylene-air flames at pressures from 77 to 17 cm Hg and are contrasted with those of Gaydon and Wolfhard for oxy-acetylene flames. In reply the latter stress the effect of burner diameter and the greater range (1 to 0·01 atm.) of their measurements. A. G. G.

536.48

6962. A theory of the film phenomena of liquid helium II. TEMPERLEY, H. N. V. *Proc. Roy. Soc. A*, **198**, 438–56 (*Aug.* 7, 1949).—A theory of the liquid He film on the general lines of that due to Schiff [*Phys. Rev.*, **59**, 839 (1941)] is proposed, the attraction between the walls of the container and the He atoms being balanced against gravity, but the wave-like nature of the He atoms and their mutual attractions being now considered. The predictions of the variation of film thickness with height agree with experiment in order of magnitude. A start is made on the problem of calculating the variation of film thickness with temp., and a new interpretation of the rate of transfer of He by the film is suggested. A

536.51

6963. Surface measurement of temperature. Calculation of heat flow into the thermometer. MOELLER, F. *Arch. tech. Messen* (*No.* 162) *Ref. V2162-2, T47–58* (*July*, 1949) *In German.*—The heat flow and temp. distribution in the system consisting of test surface, thermometer cup, and thermometer, with air gaps between the surface and cup and between cup and thermometer is treated mathematically by considering the equivalent resistance circuit. Both Hg thermometers and thermocouples are considered. Numerical values for the thermal resistances of the separate parts of the system are derived in appropriate cases, and the variation of thermal leakage from the surface with closeness of contact of the thermometer is indicated. S. W.

536.53

6964. Interpolation formulae of the platinum resistance thermometer and the platinum-rhodium/platinum thermocouple. PILIPCHUK, B. I. *J. Tech. Phys., USSR*, **19**, 667–72 (*June*, 1949) *In Russian.*—By eliminating the constants *A*, *B*, *C* from the resistance-temp. equations used with Pt resistance thermometers, a set of Lagrange formulae has been obtained. A similar expression has been obtained for the PtRh–Pt thermocouple. By applying these formulae for calculating the relations between the true and the "platinum (resistance)" or the "platinum-rhodium thermocouple)" temp., respectively, smaller errors are obtained. F. L.

536.531 : 621.317.39

6965. Resistance thermometers in unbalanced bridge connection. ENGE, H. *Tekn. Ukebl.*, **96**, 277–84 (*May* 5, 1949) *In Norwegian.*—Thermopile and resistance thermometers are compared and methods of resistance temperature measurement are reviewed. The unbalanced-bridge method when the galv. deflection is $\propto$ temperature is discussed in detail, and it is shown that linear dependence can be obtained when Ni wire is used. The making of a Ni wire element is described and the permissible current value is given. J. A. W. (R)

536.63

6966. The specific heat of Napalm-gasoline gels. LANGSTROTH, G. O. AND HART, K. H. *Canad. J. Res. A*, **27**, 151–5 (*July*, 1949).

536.63

6967. The atomic heat of elements. LEBEDEV, V. I. *Dokl. Akad. Nauk, SSSR*, **63** (*No.* 6) 645–8 (1948) *In Russian.*—It can be established that the atomic heat, just as the density, is monotonous within the group limits of the periodic system, and is a periodic function of the atomic weight. The author shows by graph and tabulation that for the fundamental groups a direct relation exists between atomic heat and atomic volume; as the latter obeys the periodic law this must also hold for the atomic heat. Some atomic heats, not yet measured, are determined by the author, viz. solid F, Sr, Ba, and for the Sc sub-group. B. F. K.

536.633.3

6968. The resonance method of measuring the ratio of the specific heats of a gas, C_p/C_v. V. Section A: An improved apparatus for measuring the ratio of the specific heats of a gas. Section B: The use of electronic counter circuits to measure low frequencies and a variable low frequency oscillator. KATZ, L., WOODS, S. B. AND LEVERTON, W. F. *Canad. J. Res. A*, **27**, 27–38 (*May*, 1949).—Describes an improved apparatus for the determination of γ by the resonance method of Clarke and Katz. The new apparatus is constructed of stainless steel and is designed to withstand pressures up to 100 atm. It is compact and can be used with corrosive gases. Provision is made for the control and accurate measurement of the temp. of the enclosed gas over a wide range of temps. An electronic counter which will measure time intervals, in units of 10 μsec, from 100 μsec to several seconds in length is described. An unknown frequency may be determined by measuring the time interval in which a preselected number of cycles occurs. The accuracy is such that frequencies may be measured to within approx. 1 part in 10^5. The circuit for a variable frequency transitron oscillator with an output of 30 W in a range of 15 to 250 c/s is shown. The stability of the oscillator is such that the frequency may easily be maintained within 1 part in 10 000 for long periods, and with care in temp. control and choice of electrode voltages much greater stabilities may be obtained. A.

536.633.3

6969. The resonance method of measuring the ratio of the specific heats of a gas, C_p/C_v. VI. Carbon dioxide, nitrous oxide, and methane. KATZ, L., LEVERTON, W. F. AND WOODS, S. B. *Canad. J. Res. A*, **27**, 39–44 (*May*, 1949).—The variation of γ with pressure has been measured. The results when extrapolated to zero pressure give values of γ_0 which are in agreement with those obtained by spectroscopic methods. Agreement in each case is better than 0·10%. A.

536.662

6970. Relationships between the atomic number, the effective atomic number and heat of combustion. LENHARD, B. *Z. Naturforsch.*, **4a**, 257–61 (*July*, 1949) *In German.*—An approximate formula for the calculation of effective atomic numbers from atomic numbers and principal quantum numbers and a formula for the calculation of heats of combustion of hydrocarbons from atomic numbers. W. R. A.

536.666

6971. The heat of formation of boron trioxide. EGGERSGLUESS, W., MONROE, A. G. AND PARKER, W. G. *Trans. Faraday Soc.*, **45**, 661–8 (*July*, 1949).—The heat of formation has been determined by a modified calorimetric method and found to be 281·1 $\pm$ 3·1 kcal/mole. A.

THERMODYNAMICS 536.7/.8

536.71

6972. Thermodynamic activity and miscibility gaps. REY, M. *C.R. Acad. Sci., Paris*, **228**, 545–7 (*Feb.* 14, 1949) *In French.*—In solutions a region of immiscibility of the components indicates a strong positive deviation from the ideal in their activities. It is shown that using the known limiting compositions of the region of immiscibility the parameters in the equations of Margules or of van Laar may be obtained and thus the activities of both components. The results are applied to the system Zn–Pb at 750°c and a value of 0·94 deduced for the activity of Zn corresponding closely to that deduced for the vapour pressure measurements of Jellinck and Wannow. The curve using van Laar's equation is said to be close to that traced by Lumsden from the same data by a more complicated method. F. E. H.

536.71

6973. Determination of the thermodynamic activity of the constituents of a molten system from the solidification diagram. REY, M. *C.R. Acad. Sci., Paris*, **228**, 473–5 (*Feb.* 7, 1949) *In French.*—Equations

are deduced for the temp. variation of the activities of the components of a system in the solid or liquid forms in terms of the values at the temp. of crystallization, the latent heat of the pure substance and its fusing temp. The deduced values for the activity of liquid Zn in the system Zn–Cd and liquid Cd in the system Cd–Pb are said to be concordant with those obtained from vapour pressure or potential measurements. F. E. H.

536.71

6974. The computation of the thermodynamic properties of real gases and mixtures of real gases. BEATTIE, J. A. *Chem. Rev.*, **44**, 141–92 (*Feb.*, 1949).—The problem to be solved in the treatment of the thermodynamic properties of gas mixtures, including mixtures in which chemical reactions may occur, is the computation of the properties of all possible mixtures (with reference to a particular standard state of the constituent gases) from thermal and compressibility data on the pure constituents alone and a knowledge of certain integration constants of the pure gases. Five methods of attack have been proposed; ideal gas formulation; method of van der Waals; Gibbs–Dalton law; Lewis and Randall rule; general limit method. The relations resulting from the first method are those usually found in thermodynamics texts and are the limiting form of the equations given by any of the other methods as the pressure approaches zero, or as the equation of state constants are allowed to approach zero. The last three methods are discussed in detail and the thermodynamic relations for gas mixtures are deduced in each case. A brief survey is given of the application of the different results to real gases. Generally it may be stated that the general limit method gives the most accurate representation of the properties of gas mixtures, the Lewis and Randall rule and the Gibbs–Dalton law frequently giving values which bracket the measured value. An extensive series of literature references is given. F. E. H.

536.71 : 541.126

6975. An equation of state for gases at high pressures and temperatures from the hydrodynamic theory of detonation. COOK, M. A. Letter in *J. Chem. Phys.*, **16**, 1165 (*Dec.*, 1948).—The author admits the validity of Paterson's criticisms [Abstr. 4568 (1949), 1176 (1948)], and points out that Paterson's recent work [Abstr. 1930 (1948)] supports his conclusion that the equation of state for gases under the conditions encountered in the detonation of solid and liquid explosives is probably of the form $pv = nRT + \alpha(v)p$. A. SCH.

536.721

6976. The equivalent of heat and the thermal unit. STILLE, U. *Z. Phys.*, **125** (*Nos* 1–3) 159–73 (1948) *In German.*—The mechanical and electrical equivalents of heat J and J' are examined. Results in terms of the standards at 3 national standardizing laboratories (PTR, NPL, NBS) lead to $J' = 4{\cdot}184(6) \pm 0{\cdot}0008\ J_{int}/cal_{15°}$ and $J = 4{\cdot}185(4) \pm 0{\cdot}0008\ Erg(M.K.S.)/cal_{15°}$ as the most acceptable values. The definitions of the 10 most usual thermal units are given, together with conversion factors in terms of J_{int} and Ergs. F. E. H.

536.7

6977. On the impossibility of attaining the absolut zero of temperature. POPOFF, K. *C.R. Acad. Sci. Paris*, **228**, 908–10 (*March* 14, 1949) *In French.*—Demonstrations by Nernst and his school depen upon power series expansions in T in the neighbou hood of the absolute zero and hypotheses concernin the coeffs. in these. A more general demonstratio of the theorem is given. Considering a Carnot cyc for which the lower temp. limit is zero it may b shown that in all cases $C_p/C_v = 1$ for $T = 0$. Fo an adiabatic change the result $dT/dv \to 0$ as $T \to 0$ i then readily deduced. F. E. H

536.7

6978. The domain of validity of the thermodynamic of irreversible processes. PRIGOGINE, I. *Physica*, 1 272–84 (*April*, 1949) *In French.*—The extension c thermodynamic methods to irreversible processe which has been performed with a high degree c success by several authors, is based on the validity c the fundamental Gibbs formula for the total dif ferential of entropy. This formula permits a straigh forward calculation of the entropy flux and also c the entropy creation due to irreversible phenomena The statistical interpretation of this formula fo equilibrium processes has been given by Gibbs. B an application of the statistical theory of irreversibl processes in gases, due mainly to Enskog and Chap man, the author shows that the fundamental Gibb formula remains valid for a large class of irreversibl processes. This class includes the transport phen mena for which the statistical distribution functio are of the form $f_\gamma = f_\gamma^{(0)} \cdot (1 + \Phi_\gamma^{(1)})$ with $f_\gamma^{(0)}$ th equilibrium distribution function and $f_\gamma^{(0)}\Phi_\gamma^{(1)}$ th second approximation function calculated by th Chapman–Enskog method. This class includes als chemical reactions slow enough as not to disturb t an appreciable extent the equilibrium form of th distribution functions of each constituent.

ELECTRICITY 537

537.081.1 : 621.3.01

6979. Definition of ideas relating to the domain electromagnetic phenomena. KALANTAROV, P. L. AN NEĬMAN, L. R. *Elektrichestvo* (*No.* 2) 16–20 (*Feb* 1949) *In Russian.*—A Soviet Commission of th electromechanical faculty of the Leningrad Poly technic Institute was entrusted with the importa task of drawing up a glossary of terms and definitio used in the domain of electromagnetism, as part the standardization of technical terminology by th Academy of Sciences of the USSR. The prese report is devoted to the definition of 144 fundamenta concepts of electrophysics and is intended to stimula discussion and criticism. B. H. (

537.081.1 : 621.3.081

6980. Dimensions and units of electromagnet quantities. BAKER, G. J. *Geophysics*, **11**, 373–8 (*July*, 1946).—A brief history is given of the confusio in the literature in regard to c.g.s. electromagnet

units and some inconsistencies are pointed out. It is contended that most magnetic measurements are of the flux density B rather than of H, and that the gamma is correctly regarded as equivalent to 10^{-5} gauss. Dimensions of the important electromagnetic quantities and the numerical relations between m.k.s. units and electromagnetic and electrostatic c.g.s. units are set forth. The adoption of m.k.s. units is urged. A.

537.081.1 : 621.3.015 : 621.3.081.1

6981. The determination of the international volt to within twenty microvolts by the application of ageing corrections to old normal Weston standard cells. HENRIKSON, A. AND SHAW, A. N. *Trans. Roy. Soc. Can.*, **42**, 37–42 (*May*, 1948).—Describes measurements at McGill University and the National Bureau of Standards, Washington, on cells made in 1909 and 1923. With the aid of a correction depending upon log (age), it is possible to reproduce an international standard e.m.f. within about 10 μV after 40 years. C. F. B.

THEORY . ELECTRONS 537.1

537.1 : 530.12

Theory of gravitation and electrodynamics. *See Abstr.* 6739

537.122

6982. Semi-classical derivation of the anomalous magnetic moment of the electron. KOBA, Z. Letter in *Progr. Theor. Phys.*, **4**, 98–9 (*Jan.–March*, 1949) *In English.*—The explanation of the Lamb shift by Welton [Abstr. 666 (1948)] is extended so as to include virtual pair creation effects and to lead to the correct anomalous moment. G. J. K.

537.122 : 530.145

On the classical equations of motion of radiating electrons. *See Abstr.* 6750

537.122 : 538.3

6983. Effect of the C-meson field on the anomalous magnetic moment of the electron. KOBA, Z., NAMBU, N. AND TATI, S. Letter in *Progr. Theor. Phys.*, **4**, 99–100 (*Jan.–March*, 1949) *In English.*—The effect has been calculated using both Schwinger's formalism and Luttinger's method and is found to be negligible. G. J. K.

ELECTROSTATICS . DIELECTRICS 537.2

537.213 : 538.12 : 621.3.011

6984. Calculation of electric and magnetic fields by the method of the potential network. GOVORKOV, V. A. *Elektrichestvo* (*No.* 3) 52–6 (*March*, 1949) *In Russian.*—Explains the principle of the relaxation method for the solution of Laplace's equation for bounded plane potential fields, showing how successive adjustments at neighbouring points of the potential grid are made by elementary arithmetical processes. Questions of convergence and continuous control of the solution are examined. Extensions of the method to plane Poissonian fields and to fields in three dimensions are suggested. The various stages in the use of the method are illustrated by computation of (i) the field of a horse-shoe magnet and its armature, and (ii) the leakage between the core and yoke of a telephone relay. B. H. (R)

537.224

6985. A capacitor made of cylinders with different temperature coefficients of expansion so as to compensate the dependence of the capacitance upon temperature. ROHRMANN, A. *Funk u. Ton* (*No.* 4) 230–3 (*April*, 1949) *In German.*—The temp. coeff. of expansion of brass increases with the Zn content. The temp. coeff. of a cylindrical capacitor made of different brasses is calculated for the general case and examples of the construction are given. C. F. B.

537.226

6986. Dielectric constant of ionic solids. JATKAR, S. K. K. AND KULKARNI, S. B. Letter in *Curr. Sci.*, **18**, 76–7 (*March*, 1949).—A discussion indicating 83% ionic character in alkali halides. D. H. W.

537.226

6987. Measurements of dielectric constant and of absorption at 3 000 Mc/s. LE BOT, J. AND LE MONTAGNER, S. Note in *C.R. Acad. Sci., Paris*, **228**, 829–31 (*March* 7, 1949) *In French.*—For diethyl ether the Debye dispersion is not reached at 10 cm. The permittivity rises linearly with H_2O content up to 1% H_2O. For liquid nitrobenzene there is strong absorption which falls sharply, but not quite to zero at the m.p. The permittivity falls similarly. D. H. W.

537.226

6988. New ferroelectric crystals. MATTHIAS, B. T. Letter in *Phys. Rev.*, **75**, 1771 (*June* 1, 1949).—In perovskites, metal-O octahedra similar in size and electron configuration to those of $BaTiO_3$, irrespective of valency, produce ferroelectric properties. $KCbO_3$, $NaCbO_3$, $KTaO_3$ and $NaTaO_3$ were found to be piezoelectric, to show dielectric hysteresis, and to make polymorphic transitions below their Curie points [*ibid.*, **76**, 175 (*July* 1, 1949)]. $LaGaO_3$ and $LaFeO_3$ also show some of the anomalous properties of BaTiO3. A. L. MAC.

537.226 : 621.315.61.011.5

6989. Measurements at higher temperatures on dielectric materials at centimetre wavelengths. BORGNIS, F. *Helv. Phys. Acta*, **2** (*No.* 2) 149–54 (1949) *In German.*—The permittivity ε and dielectric losses of certain ceramic materials and glazes were measured at cm-wavelengths in a cavity resonator, up to about 400°C. In contrast to the Mg and W glasses tested, the ceramic materials showed no real variation in dielectric loss in the range investigated; ε varied very little with temp for all the samples tried. For the glasses the loss increased by a factor of 2·5–3 for a temp. increase from 20 to 350°C. C. A. H.

537.226 : 621.317.37.029.6

6990. Method of measurement of dielectric constant and absorption at 3 000 Mc/s. LE BOT, J. Note in *C.R. Acad. Sci., Paris*, **228**, 749–51 (*Feb.* 28, 1949) *In French.*—Brief details of a method involving the measurement of the standing wave ratio looking into

a guide filled with liquid in contact with a short circuit. D. H. W.

537.226.2 : 548.3

Dielectric studies of some crystals of the Rochelle salt type. *See Abstr.* 7391

537.226.2 : 621.315.612.4

6991. Ceramic materials with a high dielectric constant. VERWEY, E. J. W. AND BÜGEL, R. D. *Philips Tech. Rev.*, **10**, 231–8 (*Feb.*, 1949).—Deals with TiO_2 as a capacitor dielectric, and shows that a material of permittivity of 100–105 and low p.f. can be produced, provided that the TiO_2 is pure initially and precautions are taken to avoid reduction during processing. The high negative temp. coeff. of permittivity of TiO_2 is a disadvantage for some applications, and methods of obtaining products of sensibly zero temp. coeff. by the addition of constituents such as CeO_2, SnO_2 or ZrO_2, which have positive temp. coeff., are described. E. R. (R)

537.226.2 : 621.315.614 : 621.3.011.5

6992. Effect of moisture content on the dielectric properties of some solid insulating materials at U.H.F. CHATTERJEE, S. K. *Indian J. Phys.*, **22**, 259–64 (*June*, 1948).—The variation of permittivity ε and p.f. of ebonite and fibre specimens with differing moisture contents are described for the range 214 to 750 Mc/s. The experimental technique of Abstr. 3758 (1948) is used. ε is found to increase with increasing moisture content. Other dielectric properties, including the temp. coeff. of ε, are calculated for differing moisture contents. The increase of ε with moisture content is explained by the relatively high value of ε for water, and the increase in p.f. by the corresponding decrease in resistance. C. A. H. (R)

537.226.3

6993. Dielectric loss in swollen rubber. SCHALLAMACH, A. AND THIRION, P. *Trans. Faraday Soc.*, **45**, 605–11 (*July*, 1949).—It is shown experimentally that the dielectric loss-tangent curves of swollen vulcanized rubbers as function of the temp. have one maximum if the swelling agent is non-polar but two maxima if it is polar. Rubber swollen in polar solvent differs therefore in its dielectric behaviour from polar liquid mixtures which have in general only one loss-tangent maximum and it is suggested that this difference is due to the chain structure of the rubber. A.

537.228.1 : 621.392.52

6994. Crystals for electrical filters. TAYLOR, R., BECHMANN, R. AND LYNCH, A. C. *Research, Lond.*, **2**, 414–17 (*Sept.*, 1949).—The following general, mechanical and electrical qualities and characteristics are important in quartz substitutes: (1) ready availability in the form of single crystals of suitable size; (2) strength without brittleness; (3) mechanical stability and permanence; (4) reasonable independence of humidity and temp. changes; (5) high piezoelectric constant d to provide high bandwidth/frequency ratio and to avoid high filter impedances; (6) suitable elastic constants, permittivity and density. Of the 32 crystal classes, 20 alone can exhibit piezoelectric effects, and of the piezoelectric minerals, none are satisfactory as regards size and quantity. A table of possible synthetic substitutes is given and the characteristics of some are described, though not one is ideal. NaK tartrate $4H_2O$ has a high d but shows a hysteresis effect, resulting in excessive damping and the generation of unwanted frequencies. $NH_4H_2PO_4$ and KH_2PO_4 exhibit hysteresis effects and high temp. coeffs. Other materials, in addition, are difficult to grow or are liable to show unwanted resonances. H. G. M. S.

537.228.4

6995. Apparatus for measuring the Kerr effect for single electric pulses. BENOIT, H. *C.R. Acad. Sci., Paris*, **228**, 1716–18 (*May* 30, 1949) *In French.*—The measurement of the Kerr effect in liquids which are electrically conducting presents many difficulties. An apparatus is described which overcomes these difficulties by applying a constant electric field for such short durations that Joule effect disturbances are negligible. A motor-driven interrupter provides pulses of up to 2 kV with a duration of < 1 msec to the plates of a Kerr cell. A double-beam oscillograph records on a time basis both the potential applied to the cell plates and the response of a photo-cell receiving the transmitted light and from these the Kerr constant and the relaxation time can be deduced. A record taken with a weak solution of thymonucleic acid shows a relaxation time approaching 0·04 sec. H. J. H. S.

537.228.4

6996. Theory of the Kerr effect of a solution subjected to a rectangular electrostatic impulse. BENOIT, H. *C.R. Acad. Sci., Paris*, **229**, 30–2 (*July* 4, 1949) *In French.*—Consideration is given to the possible use of a pulsed Kerr cell for the study of the Brownian movement of particles in suspension in a liquid. The treatment is developed mathematically but no experimental results are given. J. D. C.

ELECTRIC CONDUCTION . CURRENTS 537.3

537.311.3

6997. Measurements on the electrical resistivity of thin metallic films. VAN ITTERBEEK, A. AND DE GREVE, L. *Physica*, **15**, 80–2 (*April*, 1949) *In English.*—By means of a technique previously described [Abstr. 510, 2604 (1946)] the resistance R_c of thin Ni films is found at which these turn from conductors into semi-conductors. Cathode sputtering and vacuum condensation are used to find the effect on R_c of the gas used in the discharge and the degree of vacuum. The sputtering pressure is 10^{-1} mm Hg (10^{-5} for He), the voltage 3–4 000 V. H and A give lower values for R_c than N, He, or Ne. In the second method R_c rises with reduction of pressure. Tables and diagrams are shown. R. A. W.

537.311.3 : 541.183

6998. Reversible effect of the adsorption of gases on the electric conductivity of very thin metallic layers. MOSTOVETCH, N. *C.R. Acad. Sci., Paris*, **228**, 1702–4 (*May* 30, 1949) *In French.*—Below the threshold pressure of 10^{-4} mm Hg the effects are truly reversible. Above this limit the adsorption is irreversible. The adsorption of N, O_2, H_2, CO_2 on Mo, Pt, Rh, Ni, Au

has been investigated. The resistance of the metallic layers with negative temp. coeffs. diminishes by virtue of the adsorption of the gas and increases reversibly when the adsorbed gas is liberated. For metallic layers having a positive temp. coeff., the resistance increases when the gas is adsorbed, and diminishes at degassing. Low temps. accentuate this phenomenon. The practical application of these phenomena may result in measuring exactly pressures below 10^{-8} mm Hg. W. S.

537.311.31

6999. Some data on the electric conductivity of very thin metallic layers on different matrices. DARMOIS, E., MOSTOVETCH, N. AND VODAR, B. *C.R. Acad. Sci., Paris*, **228**, 992–3 (*March* 21, 1949) *In French.*—The value of n in the relation $R = AT^{-n}\varepsilon^{B/T}$ has been found to be independent of both the photoconductive and the supporting material. The value of n centres about 0·5. Deviations sometimes amounting to $\pm 0{\cdot}25$ seem to be due to fortuitous causes. W. S.

537.311.33

7000. Theory of the external photoelectric effect in semi-conductors. I. BaO, SrO and Cu_2O semi-conductors. (I) Behaviours of the photosensitivity near threshold. MUTO, T. AND YAMASHITA, J. *J. Phys. Soc. Japan*, **2**, 187–90 (*Nov.–Dec.*, 1947) *In English.*—It is shown how to calculate theoretically the value of the photoelectric work function from the photosensitivity curve, and also that the "mixed" photoelectric effect due to the simultaneous absorption of both an incident light quantum and a heat quantum of lattice vibrations is responsible for the "tail" part of the curve of photosensitivity of semi-conductors. Results near the threshold agree with experiments of Nishibori *et al.* [Abstr. 1378 (1941)] although the reason for the small photocurrent at the very long wavelength side is not clear. The photoelectric work function of Cu_2O is calculated to be 4·9 eV [Abstr. 1378 (1941)]. C. A. H.

537.311.33

7001. Theory of the external photoelectric effect in semi-conductors. I. BaO, SrO and Cu_2O semi-conductors. (II) Total photo-sensitivity. MUTO, T. *J. Phys. Soc. Japan*, **2**, 190–2 (*Nov.–Dec.*, 1947) *In English.*—The eigenfunctions of trapped electrons are assumed to be *s*-eigenfunctions of atomic type for the BaO and SrO semi-conductors. The total photosensitivity is then calculated, including the influence of electronic states within the impurity atoms, in this case Ba and Sr atoms respectively. C. A. H.

537.311.33

7002. Theory of the external photoelectric effect in semi-conductors. II. Coloured alkali halides. MUTO, T. *J. Phys. Soc. Japan*, **2**, 193–5 (*Nov.–Dec.*, 1947) *In English.*—The photoelectric effect due to visible light on coloured alkali halides is considered to be analogous to that of u.v. light on inorganic phosphors. A band model for the process is suggested and the theoretical determination of the total photocurrent is summarized. C. A. H.

537.311.33

7003. Concentrating holes and electrons by magnetic fields. SUHL, H. AND SHOCKLEY, W. Letter in *Phys. Rev.*, **75**, 1617–18 (*March* 15, 1949).—Positive holes were injected into a semi-conducting specimen by means of a point emitter and their concentration at a small distance monitored by a collector electrode. A direct current was passed through the specimen as for measurements of the Hall effect, and a transverse magnetic field applied. The results show that as the magnetic field (of appropriate sign) increases, holes are deflected towards the collector electrode whose contact resistance thereby decreases. For even higher field strengths the recombination of holes and electrons at the surface of the semi-conductor becomes important and the contact resistance increases again. Experiments of this kind can be used to determine surface and volume recombination constants. H. K. H.

537.311.33

7004. Deviations from Ohm's law in additively coloured alkalihalide crystals. GYULAI, Z. AND TOMKA, P. *Z. Phys.*, **125** (*Nos* 7–10) 505–16 (1949) *In German.*—As already previously observed, single crystals of additively coloured alkali halides lose their conductivity when stored at a high temp. During this process Ohm's law is not obeyed. It was found that this effect which can be observed for quite small field strengths is not due to some kind of barrier resistance. When the crystals are completely decoloured they again become ohmic, but show a new u.v. absorption band and are not, therefore, in the same state as before additive colouring ("U-centres"). The deviations from Ohm's law increase with decreasing temp. and can be eliminated by tempering. The conductivity was found to increase with increasing thickness of the crystals. It is concluded that the conduction process is not purely ionic and that the concentration of charge carriers in the interior of the crystals is augmented by some ionization process. H. K. H.

537.311.33

7005. Interpretation of dependence of resistivity of germanium on electric field. RYDER, E. J. AND SHOCKLEY, W. Letter in *Phys. Rev.*, **75**, 310 (*Jan.* 15, 1949).—By the application of pulses of up to 540 V, equivalent to fields of 6 000 V cm^{-1}, to a small wedge-shaped specimen of *n*-type Ge of resistivity 1 ohm cm and resistance 120 ohms, and with Rh-plated electrodes, it is found that any lowering of resistance on applying the pulse is not due to a bulk effect as interpreted by Bray [*Phys. Rev.*, **74**, 1218 (1948)], but rather to "transistor" action as postulated by Bardeen and Brattain [*ibid.*, **74**, 230–1 (1948)], in which positive holes are injected into the *n*-type Ge from the metal contact. C. A. H.

537.311.33

7006. Non-homogeneous distributions of impurity centres in dry rectifiers. SPENKE, E. *Z. Naturforsch.*, **4a**, 37–51 (*April*, 1949) *In German.*—Schottky's diffusion theory of barrier layer rectification is modified so as to give the voltage-current characteristic of the assembly in terms of the potential profile of the barrier. This can, in turn, be calculated for an arbitrary distribution of impurity centres. Account is taken of the space charges within the semiconductor which must inevitably accompany a non-homogeneous impurity content. An expression for the differential resistance dU/di is deduced which is analogous to Schottky's well-known capacitance

relation, though Schottky emission and other phenomena may make it difficult to verify this relation experimentally. H. K. H.

537.311.33

7007. Semiconductors. ANDREWS, J. P. *Sci. Progr.*, **37**, 435–49 (*July*, 1949).—Review: 15 refs.

537.311.33

7008. Dependence of resistivity of germanium on electric field. BRAY, R. Letter in *Phys. Rev.*, **76**, 152–3 (*July* 1, 1949).—Experiments with 5 μsec pulses indicate that positive holes are drawn into the *n*-type semi-conductor at the positive metal contact. This results in a lowering of resistivity and Hall coeff. The rate of injection increases with temp. Similar results obtained on *p*-type Ge can be accounted for by postulating the injection of electrons from the negative metal electrode. H. K. H.

537.311.33 : 621.314.634

7009. The influence of traces of thallium on the selenium rectifier. LEHOVEC, K. *Z. Phys.*, **125**, 451–4 (*March* 1, 1949) *In German.*—It was found by experiment that minute traces of Tl increase the permissible blocking voltages very considerably and reduce the time required for the forming process. Se rectifiers containing Tl have, however, inferior ageing properties. These phenomena can be interpreted by considering that Tl must act as an electron donor and is thus expected to neutralize some of the positive charge carriers in the Se. This should lead to thicker barrier layers and hence to higher blocking resistances. The high rate of diffusion of Tl in Se renders these conditions unstable. H. K. H.

537.311.62 : 621.3.018.44

7010. Anomalous skin impedance as a function of the field strength. NIESSEN, K. F. *Philips Res. Rep.*, **4**, 143–53 (*April*, 1949).—The skin effect in a metal of high conductivity is studied in the case of a strong h.f. field, using Pippard's original assumption of electrons going to and from the surface only in the normal direction. The curvature of the average electron path by the internal field is taken into account in a very simplified manner from which a dependence of the anomalous skin impedance on the field strength may be expected, viz. a decrease of the resistivity and an increase of the reactance for an increasing amplitude of the electric field on the surface. A.

537.311.62 : 621.3.018.44

7011. The skin effect problem. ZOLOTAREV, O. I. *Elektrichestvo* (*No.* 2) 59–61 (*Feb.*, 1949) *In Russian.*—A criticism and revision of Strutt's papers [Abstr. 3204 B (1927), 2200 B (1928)]. Several types of conductor and an idealized long solenoid are investigated. The following simple rule is formulated: a.c. is drawn to those cross-section points of a homogeneous conductor, where magnetic induction in the case of d.c. circulation through the system reaches a max. A. L. (R)

537.311.62 : 621.3.018.44

7012. Relaxation in the anomalous skin effect. NIESSEN, K. F. *Philips Res. Rep.*, **4**, 38–48 (*Feb.*, 1949).—If for infinitely long free paths of the electrons in Pippard's one-dimensional theory of the anomalous skin effect the relaxation is taken into account, a skin impedance is found that is independent of the conductivity. The influence of relaxation on Pippard's concept of ineffectiveness is considered. See Abstr. 3541–2 (1947). A.

537.312.5

7013. Photo-conductivity of some inter-metallic compounds. ZHUZE, V. P., MOCHAN, I. V. AND RUIVKIN, S. M. *J. Tech. Phys., USSR*, **18**, 1494–7 (*Dec.*, 1948) *In Russian.*—Photoconductivity has been established with intermetallic compounds of the permanent composition ZnSb and Mg_3Sb_2. The spectral distribution of photoconductivity has been measured. F. L.

537.312.5

7014. Theory of photoconductivity of layers of semi-conducting substances. SCHWARZ, E. *Proc. Phys. Soc. Lond. A*, **62**, 530–2 (*Aug.*, 1949).—Experiments on the influence of gases on photoconductive layers indicate that an essential condition for photosensitivity is the existence of thin films of O at the grain boundaries, together with an excess of the metallic constituent within the grains. It is postulated that hole conduction takes place within the O films and that the concentration of free holes is increased by absorbed radiation. Radiation absorbed within the semi-conducting grains increases the electron concentration. Layers which are entirely free from O are not photo-sensitive and cannot be sensitized by heat treatments alone. H. K. H.

537.321.5

7015. Application of the condenser method for the measurement of the photoelectric sensitivity of solids in powder form. PUTSEĬKO, E. K. *Izv. Akad. Nauk, SSSR, Ser. Fiz.*, **13** (*No.* 2) 224–9 (1949) *In Russian.*—The condenser method [Bergmann and Hänsler, *Z. Phys.*, **100**, 50 (1936)] in conjunction with an a.c. tube amplifier has been used for detecting the photoelectric sensitivity (in monochromatic light) not only of inorganic semi-conductors but also of various classes of organic dyes. It has been found that the spectral distribution of the photosensitivity of Se, Tl_2S and Ag_2S in powder form as determined by condenser method hardly differs from the photoconductivity curves and the photoeffect of these semiconductors in the barrier layer. Photoelectric properties have been detected in a series of organic dye-sensitizers. F. L.

537.312.5 : 535.23.08

7016. Increased sensitivity of infra-red photoconductive receivers. WATTS, B. N. Letter in *Proc. Phys. Soc., Lond. A*, **62**, 456–7 (*July*, 1949).—The anomalous relationship between the conductance of i.r.-sensitive surfaces and low ambient temps. is shown to be an effect of the incident background irradiation. By removing this source of background noise the sensitivity can be increased appreciably and continuously. The ratio of the sensitivity of a PbS cell first at room temp. and then at liquid air temp. $\geqslant 1\,000$. The signal-to-noise ratio is reduced for incident radiation of long wavelengths (room temp.) as well as for short wavelengths (tungsten lamp). W. S.

537.312.5 : 535.233.5 : 621.383

7017. The sensitivity of various phototubes as a function of the color temperature of the light source.

CRAMWINCKEL, A. M. *J. Soc. Mot. Pict. Engrs*, **49**, 523–9 (*Dec.*, 1947).—A description is given of a measuring method and measurements for ascertaining the sensitivity of different types of phototubes, viz. caesium-oxide gas-filled and vacuum phototubes, caesium-antimony vacuum phototubes, and selenium photo-voltaic cells, as a function of the temp. of the light source (tungsten ribbon lamp). The results are compared with the surface brightness of the light source as a function of the temp. P. A.

537.312.5 : 535.37

7018. Absence of photo-conductivity in tungstate phosphors. KLICK, C. C. AND SCHULMAN, J. H. Letter in *Phys. Rev.*, **75**, 1606–7 (*May* 15, 1949).—Working with synthetic single crystals of Scheelite ($CaWO_4$) and taking care not to illuminate the electrodes, it has been found impossible to confirm the photoconductivity of this crystal, or the excitation by Hg 3 650 group, reported by Randall and Wilkins [Abstr. 756 (1946)]. It is suggested that these effects were due to impurities. J. E.

537.312.5 : 621.383

7019. Dark current and photo-current in Cu_2O in alternating electric fields. GUDDEN, B. AND HENNINGER, P. *Z. Phys.*, **125** (*Nos* 11–12) 757–66 (1949) *In German.*—The purpose of the investigation was to determine the effect of grain boundaries on the photoconductive properties of crystalline Cu_2O. It was found by bridge and resonance methods that the dark-conductivity is independent of frequency between 0 and 16 Mc/s. The photo-current is independent of frequency up to 80 kc/s, then decreases approximately as the log of the frequency and regains a constant value at about 10 Mc/s. These relations are independent of field strength. Slight time delays between the onset of radiation and the photo-current were observed. These phenomena are interpreted by taking account of the finite life-time of the charge carriers released by incident radiation. The permittivity of Cu_2O was found to be 7·88. H. K. H. (R)

537.312.5 : 621.383.4

7020. Photoconductivity of naphthalene and anthracene. BAYLISS, N. S. AND RIVIERE, J. C. Letter in *Nature, Lond.*, **163**, 765 (*May* 14, 1949).—Anthracene and naphthalene, after having been melted and allowed to solidify in vacuum between electrodes, show photoconductivity. The photo-current/incident-radiation ratio is constant. Voltages up to 360 V have been employed on a cell 0·5 mm thick. It is assumed that λ1849 (Hg) is the active radiation. W. S. (R)

537.312.5 : 621.385.1.032.216 : 621.383

7021. Photoelectric effect in oxide-coated cathodes. DEBIESSE, J. AND CHAMPEIX, R. *Vide*, **4**, 545–52 (*Jan.*, 1949) *In French.*—Part I deals with experiments, II with theory. The photosensitivity of a cathode at ambient temperature and with constant illumination increases over a period of about 30 min and then becomes constant. If a heated cathode is illuminated the current drawn to the anode increases by an amount depending on the voltage. The max. is of the order of some mA at 20–30 V. As a function of cathode temperature this effect is max. at 850–900°K. In the retarding field region the current can be reduced or even reversed. This effect is due to gas ionization. The photoelectric threshold is between 2·08 and 2·15 eV. When the light source is interrupted a second max. occurs at about 1 200°K. Cathodes which had been broken down but not activated showed sensitivities up to half those of standard Cs cells. Fully activated cathodes showed much smaller sensitivities. It is concluded that the photo-ionization of the surface Ba creates a field across the cathode which acts so as to reduce the resistance thereof. Activation corresponds to an almost complete surface layer and thus gives lower quantum efficiency. A. H. W. B. (R)

537.312.6

7022. The calculation of the "ideal" resistance of metals at low temperatures. VAN DEN BERG, G. J. *Physica*, **15**, 65–70 (*April*, 1949) *In English.*—A formula due to Van der Leeden (1940) is shown to agree with the physical nature of the problem for substances which do not obey Matthiessen's rule, and it fits well the experimental results of Van den Berg and de Haas for Au even below 1°K. For Cu annealed at 500°c Matthiessen's rule may be applied, but Van der Leeden's formula for such cases fits the results better. A method of calculating the ideal resistance of super-conductors with a high transition point is given and the problem of the resistivity of a metal wire as a function of the diameter is discussed. C. A. H.

537.312.62

7023. Penetration of magnetic field into superconductors. II. Measurements by the Casimir method. LAURMANN, E. AND SHOENBERG, D. *Proc. Roy. Soc. A*, **198**, 560–81 (*Sept.* 7, 1949).—The changes with temp. of penetration of a magnetic field into superconducting Sn and Hg were studied by a method due to Casimir in which a mutual inductance with a superconducting core is measured using low-frequency currents. The results were found to be very sensitive to surface conditions, but single crystals with smooth surfaces gave reproducible measurements of $\lambda(T) - \lambda(2{\cdot}17°\text{K})$ as a function of temp. T. These were consistent with the formula $\lambda(T) = \lambda_0(1 - (T/T_c)^4)^{-\frac{1}{2}}$, where T_c is the transition temp., and λ_0 was found to be $5{\cdot}2\times10^{-6}$ cm for Sn and $4{\cdot}3\times10^{-6}$ cm for Hg. For Sn there was no significant difference between the values of λ_0 for current flow in different crystal directions, though a difference of up to 20% is not excluded. For Hg there is a suggestion that λ_0 is about 20% higher for current flow perp. to the principal axis than it is for current flow parallel to the principal axis, but this difference is little more than might be due to experimental errors. There was no evidence for any dependence of λ on a steady magnetic field H, though an increase of 10% up to 80% of the critical field is not excluded. A.

537.312.8

7024. Change of electrical resistance of different conductors in a magnetic field. KOHLER, M. *Naturwiss.*, **36** (*No.* 3) 86 (1949) *In German.*—A preliminary account is given of a theoretical treatment to interpret the abnormal resistance properties of certain metals, mainly divalent, when placed in a strong transverse magnetic field. The treatment is based on a two-band model, and it is assumed that the numbers of

electrons in the two bands are equal, the electron gas is completely degenerate and the band overlap is not too pronounced. The treatment is general in that no assumptions need be made as to electron-lattice interaction, the distribution of the electronic energy states and the lattice type. The marked changes of resistance are due to a compensating effect of the two bands, similar to that giving rise to the anomalous Hall effect. E. P. W.

537.312.9

7025. Pressure change of resistance of tellurium. BARDEEN, J. Letter in *Phys. Rev.*, **75**, 1777–8 (*June* 1, 1949).—It has been observed by Bridgman that the resistivity of Te decreases by a factor of over 600 at a pressure of 30 atm. An analysis of his measurements at different temps. shows that the decrease is due to the diminishing energy gap between the filled and the conduction bands. For very high pressures this gap width tends to zero so that the material may ultimately be a true metallic phase. H. K. H.

537.315 : 621.3.014.1

7026. Current flow in a parallel plane conductor with circular electrodes. NOMURA, Y. *Sci. Rep. Tôhoku Imp. Univ.* (*Ser.* 1) **30**, 363–71 (1942).—The stationary flow is calculated; the potential distribution on either electrode may be arbitrary. The problem is solved by means of Fourier series and Bessel-function integrals. The coeffs. of the series follow from an infinite set of linear equations. Numerical results are given for the case where the potentials at the electrodes are constant and equal but of opposite sign. The equivalent resistance of the conductor is calculated. M. R.

537.322.4

7027. On normal currents caused by potential and temperature gradients. PERRIER, A. *Physica*, **15**, 76–9 (*April*, 1949) *In French.*—If a temp. gradient is maintained parallel to a generator of a tubular cylinder of an unmagnetized ferromagnetic material, and meanwhile a coaxial couple is applied to the tube, there are found to be currents flowing in the cylinder so long as it is deformed, the current strength being reversibly dependent on the deformation. The effect has been systematically investigated for Fe and Ni with tubes 2·4/2·6 cm in dia. and about 40 cm long. The relation between current strength and deformation within the region of stress for which Hooke's law holds, is found to be similar to that between intensity of magnetization and strength of magnetizing field. The saturation current is about 0·4 amp cm^{-2} for Ni and 0·1 amp cm^{-2} for Fe. An explanation based on Weiss ferromagnetic domains is given. C. A. H.

537.36 : 532.13

Electroviscosity. *See Abstr.* 6776

ELECTRIC DISCHARGES 537.52

537.521 : 537.56

7028. Similarity relationships in gas discharges with external ionization. FUCKS, W. *Naturwiss.*, **35** (*No.* 9) 282–3 (1948) *In German.*—The significance of the similarity relationship for gaseous discharges is discussed. For a given value of electrode separation/mean free path most theories give a unique finite value of the sparking potential U. Choosing a further variable—that of external ionization i_1—values of U_1 are obtained corresponding to i_1. Thyratron discharges and arcs can be regarded as glow discharges with extra ionizing sources. Two special cases are considered corresponding to constant and variable external ionization. F. LL. J.

537.523 : 621.315.618

7029. Effect of high voltage electrical discharges on sulfur hexafluoride. SCHUMB, W. C., TRUMP, J. G. AND PRIEST, G. L. *Industr. Engng Chem.*, **41**, 1348–51 (*July*, 1949).—An examination of the stability of SF_6 when exposed to corona or spark-over discharges. SF_6 is decomposed under corona discharge, and more rapidly under spark-over conditions, forming lower valency fluorides of S and fluorides of the metals forming the electrodes of the electrical apparatus. The corrosion damage thereby brought about may be of serious magnitude when operation is extended over many hours. Possibility of reducing the extent of such damage by use of suitable absorbents, such as activated alumina and soda lime, is indicated. Presence of organic matter, such as fabric belts, rubber, plastics, etc., complicates the corrosion problem and that of removal of decomposition products. Because the decomposition of SF_6 under discharge forms F and lower valency fluorides, a résumé of the present state of knowledge concerning these little-known compounds is included, and a method is suggested whereby the hexafluoride may be freed of contamination by the lower valency compounds. A.

537.523.3 : 621.3.015.532

7030. The space charge due to corona. SMITH, O. J. M. *Trans. Amer. Inst. Elect. Engrs*, **67**, *Pt II*, 1137–44 (1948).—The field strength about a wire under corona is measured by means of a crystal galvanometer connected between two probe screens. From these data the net space-charge density is derived mathematically. A graphical method is described for determining the charge from the curves of field strength against distance. The mechanism of the motion of ions in an a.c. corona envelope is discussed. Rough calculations of the ion mobility yield 3 to 4 cm/sec per V/cm which agrees well with more precise data. R. G. H. (R)

537.523.5

7031. On the temperature in the region near a freeburning low current carbon arc. MAECKER, H. AND SPERLING, J. *Naturwiss.*, **35** (*No.* 8) 253–4 (1948) *In German.*—Measurements were made, with a Schlieren technique, of the temp. variations in the space near an arc burning in air. For a 10 A arc, 1·7 cm long, the temp. varied from about 2 300°K at about 0·35 cm from the arc axis to about 300°K at about 1·3 cm. Measurements could not be made nearer to the arc axis. Temp. plots, and a diagram of the optical system, are given. J. D. C.

537.525

7032. An error in a paper by Landau on Coulomb interactions in a plasma. ALLIS, W. P. Letter in

Phys. Rev., **76**, 146 (*July* 1, 1949).—The Coulomb interactions of electrons and ions in a plasma cannot be represented as the divergence of a flow vector in momentum space, as suggested by Landau [*Phys. Z. Sowjetunion*, **10**, 154 (1936)]. G. J. K.

537.525.3

7033. Production of the Joshi effect in the aerial current under electrical discharge in chlorine. PRASAD, B. B. *Proc. Indian Acad. Sci. A*, **29**, 322–9 (*May*, 1949).—Further expts. on the Joshi effect are described. The new data were obtained with 300 mm Hg press. of purified Cl in a Siemens' ozonizer and the effect was demonstrated with the aid of h.f. oscillations transmitted from the tube to a suitable receiving aerial. The effect of altering various parameters is described in detail. J. D. C.

537.525.3

7034. Production of Joshi effect in iodine vapour in electric discharge. DESHMUKH, G. S. *Proc. Indian Acad. Sci. A*, **29**, 243–64 (*April*, 1949).—Describes in great detail the Joshi effect [see Abstr. 1786, 2049, 2566 (1944), 2531 (1949), etc.] in ozonizer discharges, which were excited by power frequency high voltage sources. The Joshi effect, i.e., the reduction in discharge current due to the influence of external sources of radiation, was studied and is tabulated as a function of various parameters. Joshi suggested that the effect was due to liberation of photo electrons, from the walls of the ozonizer tube, which suffered attachment to atoms or molecules in the discharge space and thus formed negative ions. This theory is discussed but it appears impossible at the present to draw final conclusions. J. D. C.

537.525.3 : 535.343.4

7035. Light absorption by iodine vapour under conditions productive of Joshi effect. RAO, K. V. *Proc. Indian Acad. Sci. A*, **29**, 211–17 (*April*, 1949).—Experiments on the absorption spectrum of I vapour in various ozonizer tubes of Siemens' type were made, with the purpose of elucidating the Joshi effect. [See above Abstr.]. It was found that the absorption spectra of excited and unexcited I vapour were sensibly the same, suggesting that the explanation of the Joshi effect may be found in terms of the properties of adsorbed layers on the ozonizer tube walls, and not in terms of absorption phenomena in the gas. J. D. C.

537.525.5

7036. The temperature of the cathode spot in a mercury arc. LUTZ, A. *C.R. Acad. Sci., Paris*, **228**, 912–14 (*March* 14, 1949) *In French.*—The method of measurement of the cathode spot temp. consists in observing the i.r. spectrum emitted by the spot, and comparing it with the spectrum emitted from Hg at a known temp. The results indicate that, for the particular conditions of the expt., the cathode spot temp. was about 400°C. J. D. C.

537.525.6

7037. The conductivity of ionized air in a high frequency alternating field. SZÉKELY, A. *Acta Phys. Austriaca*, **3** (*No.* 1) 22–37 (1949) *In German.*—The air-filled space between two condenser plates was ionized by means of an electron beam (600 eV, $\leqslant 3$ μA current) and the resulting conductivity of the space determined for frequencies lying between 3 and 5 Mc/s. The pressure range was about 0·04–0·1 mm Hg. The variation of conductivity with frequency and current strength is interpreted in terms of a simple theory involving dipoles. J. D. C.

537.525.8

7038. Production of the Joshi effect in Br_2 and H_2 and their mixtures. VISVANATHAN, K. S. AND RAGHAVAN, V. S. *Proc. Indian Acad. Sci. A*, **29**, 98–106 (*Feb.*, 1949).—Describes expts. on the Joshi effect (i.e. the instantaneous and reversible change of discharge current in, e.g., an ozonizer when the system is irradiated) in Br and H contained in Siemens' ozonizer tubes and excited with a 500 c/s high voltage discharge. Measurements with Br/Cl mixtures show the effect very strongly. J. D. C.

537.525.8

7039. Production of the Joshi-effect in air under silent electric discharge. VISVANATHAN, K. S. AND RAO, B. L. *Proc. Indian Acad. Sci. A*, **29**, 117–36 (*March*, 1949).—Describes expts. on the Joshi effect in dry, dust-free air, with a 500 c/s high voltage discharge. The influence of the tube surfaces in the ozonizer was studied with surface films of KCl, $BaCl_2$, $HgCl_2$ and NaOH. J. D. C.

537.525.8

7040. The role of intensity, frequency and amount of irradiation in Joshi-effect. TAWDE, N. R. AND GOPALKRISHNAN, K. *Proc. Indian Acad. Sci. A*, **29**, 171–88 (*March*, 1949).—The Joshi effect in Cl and air was re-studied in a Siemens' ozonizer. Illumination at various wavelengths was provided with a suitable system of filters and lamp. It is concluded that wall effects are important but no detailed mechanism is suggested. J. D. C.

537.525.82 : 537.531

7041. The Lilienfeld radiation and its interpretation in terms of plasma oscillations at the metal surface. SOMMERMEYER, K. *Naturwiss.*, **36** (*No.* 3) 87–8 (1949) *In German.*—The Lilienfeld radiation appears as a greenish-blue light ($\sim$4 000–5 000 Å wavelength) at the anode of certain X-ray tubes. The note enumerates the characteristics of the radiation, for example that it is more noticeable with roughened anode surfaces, and concludes with a short suggested explanation of the phenomenon in terms of plasma oscillations. J. D. C.

537.525.92 : 537.533.7 : 621.385

7042. A note on plasma oscillations. PIERCE, J. R. Letter in *Phys. Rev.*, **76**, 565 (*Aug.* 15, 1949).—A short note directing attention to previous expts. by the author [see Abstr. 2133 (1948)] and the theoretical work of Bohm and Gross [Abstr. 4062 (1949)] with which good agreement is obtained. J. D. C.

X-RAYS 537.531

537.531

7043. Determination of the energy distribution of bremsstrahlung from 19·5 Mev electrons. KOCH, H. W. AND CARTER, R. E. Letter in *Phys. Rev.*, **75**, 1950–1 (*June* 15, 1949).—Bremsstrahlung from a thin

Pt target bombarded by 19·5 MeV electrons in a betatron were directed in a collimated beam into a cloud chamber filled with air to 1·4 atm. The energy distribution of the electron positron pairs produced in the gas was obtained from stereoscopic pictures of the tracks, in 1 540 gauss magnetic field and the X-ray spectrum was deduced, using known data on pair production cross-sections. The spectrum was found to deviate from that predicted by the Bethe–Heitler theory, the experimental distribution having relatively more quanta in the middle energy region.

L. R. S.

537.531 : 535.3

7044. The Mn *K*-absorption edge in manganese metal and manganese compounds. HANSON, H. AND BEEMAN, W. W. *Phys. Rev.*, **76**, 118–21 (*July* 1, 1949).—The Mn *K* edge has been measured in twelve different states of chemical combination with a high resolution double crystal spectrometer. The "white line" at low energies in $KMnO_4$ is shown to be characteristic of the compound and not of impurities. Less intense low energy absorption is observed in several other compounds. It is believed due to the mixing of states of different angular momentum accompanying homopolar bonding, which thus makes available *p*-type function at lower energies than would be the case in a purely ionic compound. A.

537.531 : 535.3

7045. Scattering of X-rays by dense systems of identical particles. FOURNET, G. *C.R. Acad. Sci., Paris*, **228**, 1421–3 (*May*, 1949) *In French.*—See Abstr. 2539 (1949). A new equation for the small-angle scattering is derived, based on the partition function of Born and Green [Abstr. 771 (1947)]. No regions of negative intensity are predicted.

A. J. C. W.

537.531 : 535.312

7046. A method for the comparison of the intensities of X-ray reflections using nuclear research emulsions. WELLARD, H. J. *Acta Cryst.*, **2**, 338–9 (*Oct.*, 1949) *In English.*—The number of electron tracks per unit area is a direct measure of the intensity of the beam. The method is particularly suited for short wavelengths and small film-specimen distances. A. J. C. W.

537.531 : 535.33

7047. X-ray collimator producing a beam of very small divergence and large intensity. LELY, J. A. AND VAN RIJSSEL, T. W. *Acta Cryst.*, **2**, 337–8 (*Oct.*, 1949) *In English.*—Slits constructed of polished glass blocks with a critical angle $\eta < 15'$ produce strong beams of small divergence. The effective angular width α_0 of the entering beam is $2\eta + \beta$, where β is the angle between the blocks. Total reflection at the glass surfaces reduces the angular width α_e of the emergent beam to a small fraction of this. A typical slit is 12 cm long, 9 μ at the focal-spot end and 140 μ at the specimen end, $\alpha_e = 5 \cdot 8'$. A square "pin-hole" collimator can be made of 4 polished blocks. A. J. C. W.

537.531 : 535.331

7048. Weak emission lines in the $L\alpha$ spectrum of $_{80}$Hg. GROVEN, L. AND LAGASSE, A. *C.R. Acad. Sci., Paris*, **228**, 1642–4 (*May* 23, 1949) *In French.*

537.531 : 535.331

7049. The *L* spectrum of element 61. PEED, W. F., SPITZER, E. J. AND BURKHART, L. E. Letter in *Phys. Rev.*, **76**, 143–4 (*July* 1, 1949).—The *L* spectrum of element 61 was obtained in the same way as its *K* spectrum [Abstr. 2535 (1949)]. The wavelengths of $L\alpha_2$, $L\alpha_1$, $L\beta_3$, $L\beta_2$ and $L\gamma_1$, are given using the wavelengths of $Nd\alpha_1$, $Sm\alpha_1$, $Nd\beta_1$ and $Sm\beta_1$ as standards. A weak line $\lambda = 1\,931 \cdot 3 \pm 0 \cdot 4$ XU has not been satisfactorily identified, being probably too weak to be $Nd\gamma_5$. R. B. S.

537.531 : 535.343

7050. The X-ray-absorption edges L_I of tantalum and of tungsten and L_{II} and L_{III} of platinum. COSTER, D. AND DE LANG, H. *Physica*, **15**, 351–7 (*May*, 1949) *In English.*—In contradiction to previous results obtained by the authors [Abstr. 3268 (1947)], it has now been established that the L_I-edges of Ta and W show a structure, as stated by Bearden and Snyder [Abstr. 620 (1941)]. This structure appears to be related to the fact that the unoccupied levels of low binding energy of these metals are not strictly of a definite nature, but more of a mixed *d–p* and probably also *s*-character. The wavelengths of the L_I-edges of W and Ta are given as 1 022·5 X.U. and 1 059·5 X.U. respectively. The difference in the structure between the L_{II} and L_{III}-edges of Pt is discussed in comparison with the identity of structures between L_{II} and L_{III}-edges of W. R. H. H.

537.531 : 535.42

7051. Application of the theory of Born and Green on the calculation of the intensity [of X-rays] diffracted by gases and liquids. FOURNET, G. *C.R. Acad. Sci., Paris*, **228**, 1801–3 (*June* 8, 1949) *In French.*—A modification of a mathematical expression for the intensity of X-rays diffracted by spherical particles based on the kinetic theory of liquids by Born and Green permits the application of this formula both for gases and liquids. Diffraction experiments using A as a gas and as a liquid near its boiling point show good agreement with the theoretical results which are shown in graphs. R. H. H.

537.531 : 535.434 : 541.18.02

7052. Dependence of the small-angle X-ray scattering on the shape and ordering of the colloid particles in close-packed systems. I. The lamella-packet. POROD, G. *Acta Phys. Austriaca*, **3** (*No.* 1) 66–81 (1949) *In German.*—The small- and smallest-angle scattering for a system of lamellae of varying thickness separated by liquid layers, also of varying thickness, is worked out with a view to applications to cellulose fibres. Gaussian and Maxwellian distributions are used. Dilute systems give a Gaussian intensity distribution about the primary beam, those of medium density give a liquid-like intensity distribution, and close-packed systems give a very strong smallest-angle scattering, rapidly falling off to a liquid-like small-angle scattering. A. J. C. W.

537.531 : 539.166

7053. Spectroscopic measurements of the X-radiation from radioactive elements. MARMIER, P., BLASER, J.-P., PREISWERK, P. AND SCHERRER, P. *Helv. Phys. Acta*, **22** (*No.* 4) 155–63 (1949) *In French.*—The efficiency ("signal-to-noise ratio") of a Cauchois

curved-crystal spectrometer is discussed as a function of its dimensions and proportions. The efficiency increases with the size, but the time required to make the measurements also increases; for a fixed measuring time the statistical errors are least for a focusing circle of radius a few decimetres. For an extended source the distance from detector to crystal should be 3 times the distance from crystal to source. The spectrometer as constructed consists of a semi-circular base on which the focusing circle 33 cm in diameter can be rotated. The focusing circle carries either a Geiger counter, maintained in correct alignment with the crystal (mica or quartz) by means of an arm, or a film cassette. Photographic measurements on Tc (element 43) gives $K\alpha_2 = 677{\cdot}9$, $K\alpha_1 = 673{\cdot}4$, $K\beta_1 = 600$ *X*, in good agreement with Burkhart *et al.* [Abstr. 1253 (1948)]. A. J. C. W.

537.531 : 621.384.6 : 621.385.833

7054. Electron gun emission and X-ray output for three betatrons. WESTENDORP, W. F. AND ELDER, F. R. Letter in *Phys. Rev.*, **76,** 445 (*Aug.* 1, 1949).—Measurements have been made on the X-ray output of 3 betatrons (100 MeV, 50 MeV and 10 MeV) as a function of electron gun emission and voltage. All the output curves showed an initial increase faster than a linear increase with current, as expected from Kerst's theory [Abstr. 241 (1949)]. Output finally saturates, the saturation output varying approx. as (gun voltage)$^{1{\cdot}25}$. J. H. F.

CATHODE RAYS . POSITIVE RAYS 537.533/.534

537.533

7055. Multiple production of photons in bremsstrahlung. D'ESPAGNAT, B. *C.R. Acad. Sci., Paris,* **229,** 22–4 (*July* 4, 1949) *In French.*—The high-frequency divergence which arises in the Bloch–Nordsieck treatment of bremsstrahlung [Abstr. 4026 (1937)] may be avoided by regarding the electronic velocity as a continuously varying quantity. P. M. D.

537.533 : 621.384.6

7056. Linear accelerators. FRY, D. W. AND WALKINSHAW, W. *Rep. Phys. Soc. Progr. Phys.*, **12,** 102–32 (1948–49).—A review of linear accelerators with special reference to electron accelerators. Both travelling-wave and standing-wave accelerators are discussed from the aspects of axial and radial stability of the beam, efficiency is expressed as shunt impedance per metre, and power feeding. These problems have been explored and largely solved on existing machines. The main need is for single sources of higher r.f. power. The linear electron accelerator is capable 60–600× the mean beam current of a betatron or synchrotron, and energies up to 1 000 MeV may prove practicable. W. I. B. S.

537.533 : 621.384.6

7057. Contraction of the instantaneous orbit at injection in a betatron. HEYMANN, F. F. *Phys. Rev.*, **75,** 1951–2 (*June* 15, 1949).—A new method of contracting the initial orbit is described which gives a useful increase in number of particles missing the injector during the first few revolutions. The Ag coating of the vacuum chamber is biased up to 1 000 V negatively relative to the injector anode. With injector voltages of 8 kV and 11 kV in the Metropolitan–Vickers 20 MeV betatron a gain in output occurs of 6 times and 2–3 times respectively. [See Abstr. 241 (1949)]. J. H. F.

537.533 : 621.384.6

7058. High current betatron conditions. LATHAM, R. AND PENTZ, M. J. Letter in *Nature, Lond.*, **164,** 485–6 (*Sept.* 17, 1949).—A theory relating the flux linking the stable orbit to the guide field when the current of accelerated electrons is large. The 2 : 1 flux to guide field law is altered when the number of electrons per cm^3 is $> 10^8$. Space charge effects are neglected. The betatron must be considered as a loaded transformer. W. I. B. S.

537.533/.534 : 621.384.6

7059. Particle accelerators. LIVINGSTON, M. S. *Adv. Electronics*, **1,** 269–316 (1948).—An introductory survey; the general principles and basic theory are given in the following main sections: resonance accelerators; induction accelerators; relativistic equations of motion; principles of phase stability; the synchrotron; the synchro-cyclotron; the linear accelerator; future possibilities, the proton synchrotron. (32 refs.)

537.533.72

7060. Derivation of some of Picht's formulae in electron optics. FORNAGUERA, R. O. *An. Real Soc. Esp. Fis. y Quim. A,* **44,** 70–9 (*Jan.–Feb.*, 1948) *In Spanish.*—Starting from the fundamental differential equation, the theory of integral equations is applied to the calculation of the cardinal elements of an electron lens. L. P.

537.533.72/.534.72 : 621.385.833

7061. The deflection of beams of charged particles. HUTTER, R. G. E. *Adv. Electronics*, **1,** 167–218 (1948).—A unified presentation is given of the theory of electron and ion "prisms," using electron-optical methods throughout, and several designs of prisms having improved properties are discussed. Beam-focusing effects are invariably associated with deflection produced by simple fields, and the effects increase with the angle of deflection. They are ordinarily undesirable in small-angle deflection devices, but are very useful in instruments embodying large-angle deflection.

537.533.72 : 621.385.833

7062. An aberration phenomenon in electrostatic lenses. HARRISON, S. Letter in *J. Appl. Phys.*, **20,** 412–14 (*April*, 1949).—An explanation, based on spherical aberration, of the kidney-shaped dark patches observed in c.r.ts. subjected to an extreme degree of de-focusing. A. H. W. B.

537.533.72 : 621.385.833

7063. Electron scattering and image formation in the electron microscope. v. BORRIES, B. *Z. Naturforsch.*, **4a,** 51–70 (*April*, 1949) *In German.*—It follows from the intensity distribution of electrons that they will be located outside the beam after a single elastic collision. The illumination thickness is defined as the object thickness, in mass units, in which the electrons on the average sustain one collision, i.e. the initial number of electrons is divided by the factor *e*. The

illumination thickness is evaluated as a function of primary energy and of the material: it proves a good measure of the thickness which can be examined with good illumination and resolving power. A similar quantity, the brake thickness, is defined and evaluated for inelastic collisions. It is of the same order of magnitude as the illumination thickness and depends on the diamagnetic susceptibility. Quantitative examples are given and the problems of picture formation discussed. A. H. W. B.

537.533.72 : 621.385.833

7064. Method of measuring spherical aberration of an electron microscope objective. HALL, C. E. Letter in *J. Appl. Phys.*, **20**, 631–2 (*June*, 1949).—The displacement of a diffraction image from the in-focus paraxial image of the diffracting crystal is used to measure the aberration. The (200) diffraction image of MgO was used for the measurement. The value of $Cf = 1{\cdot}6$ was obtained for a R.C.A. type B microscope. A. H. W. B.

537.533.72 : 621.385.833

7065. Resolving power and limiting magnification of the magnetic electron microscope as a function of beam energy and magnetic field strength. GLASER, W. *Acta Phys. Austriaca*, **3** (*No.* 1) 38–51 (1949) *In German.*—A rigorous wave mechanical treatment yields explicit expressions for the resolving power and magnification. The beam energy for which the chromatic aberration is harmless (i.e. for which it produces only a certain proportion of the calculated limit of resolution) is also evaluated. The resolution is given by $d_{min} \doteq 6{\cdot}93\times10^{-5}\{B_0U(1 + 0{\cdot}97\times10^{-6}U)\}$ mm. This leads to values of ~ 4 Å at 60 kV. Measured values are considerably greater, mainly owing to field asymmetry. A. H. W. B.

537.533.72 : 539.165

7066. Electron trajectories in a gamma-ray spectrometer. HURWITZ, H., JR. Letter in *Rev. Sci. Instrum.*, **20**, 318 (*April*, 1949).—The spectrometer of Lawson [Abstr. 2726 (1949)] deflects + and − electrons from a target on the edge of an axially symmetric magnetic field. The deflection of an initially radial ray may be computed from an integral which is here given in a form suitable for numerical integration. J. C. E. J.

537.533.72 : 539.165

7067. Classification of the envelopes of trajectories of β-rays in an inhomogeneous magnetic field. THIBAUD, J. *Rev Sci., Paris*, **86**, 455–63 (*May–June*, 1948) *In French.*—Trajectories in almost homogeneous magnetic fields have been described [Abstr. 4449 (1933), 3020 (1934) and 421 (1939)]. The effects of a strong field gradient, which can also focus particles with spin, have been described in Abstr. 1640 (1948) and 286 (1949). The present paper reviews this latter subject, giving photographs and diagrams of patterns observed with various β-sources placed in the plane of symmetry but outside the periphery of 2 cylindrical magnetic poles, 24 cm in dia. [cf. Abstr. 1577 (1948)]. An observation apparently not hitherto reported is of striations which are interpreted as interference fringes. A theory is developed explaining them as due to particles of moment $\mu \sim 10^{-13}$ e.m.u. and with $m_0 \sim 10^{-6}\times$ rest mass of the electron. It is supposed that they may lose so much momentum due to the high $\partial H/\partial z$ that their corresponding wavelength becomes great enough for an interference pattern to be observable. J. C. E. J.

537.533.72 : 539.165

7068. A new type of focusing in a magnetic lens field. SLÄTIS, H. AND SIEGBAHN, K. Letter in *Phys. Rev.*, **75**, 1955 (*June* 15, 1949).—A preliminary description, with diagram, of a β-spectrometer in which there is a field minimum mid-way between source and detector. With a strong enough field gradient, rays from the source are concentrated into an annulus in this mid-plane, where a ring baffle may be placed. For a given ring radius, a certain field gradient gives optimum transmission, which may be e.g. 8%, with a resolving power of 4%. Scattered radiation is strongly suppressed. J. C. E. J.

537.533.72 : 539.165

7069. New application of axial magnetic fields in β-spectrometry. GEORGESCO, M. *C.R. Acad. Sci., Paris*, **229**, 297–9 (*July* 25, 1949) *In French.*—A lens β-spectrometer is proposed in which the rotation of the image with respect to the object, instead of the object-image distance, is measured. This arrangement gives, especially at low energies, a higher dispersion than does the focal isolation method. To compensate for certain aberrations it is proposed to give a 3-dimensional curvature to the source. [This type of spectrometer was also proposed in Abstr. 1138 B (1942).] J. C. E. J.

537.533.72 : 539.165

7070. The electron optical properties of the focal isolation β-ray spectrometer. BUTT, D. K. *Proc. Phys. Soc., Lond. B*, **62**, 551–64 (*Sept.*, 1949).—An attempt is made to show theoretically how the performance of a lens spectrometer depends upon the degree of spherical aberration present in the lens. In particular, curves of resolving power and transmission are plotted against radius and area of the central lens annulus, for source and counter window on the axis and of equal diameter. The resolving properties of a circular source and counter window placed at equal distances off the axis are determined. The arrangement is found to be impracticable. Lastly, an investigation is made into the resolving properties of a line source placed at right angles to the axis of the spectrometer, the image of which is focused into a slit-shaped window in a counter. The arrangement is shown to be advantageous particularly when long solenoids are employed, as in high energy β-spectroscopy. A.

537.533.74

7071. Experiments on the single scattering of electrons. BOTHE, W. *Z. Naturforsch.*, **4a**, 88–94 (*May*, 1949) *In German.*—A 50 mC Ra($D + E$) source was placed at the pole edge of an axially symmetrical magnetic prism, used as a monochromator, and the field and stop were so adjusted that the emergent beam was $\parallel$ both in the plane of symmetry and in that $\perp$ to it. This monoenergetic beam struck a thin foil and electrons scattered through $\sim 110°$ were focused by a semi-circular spectrometer on to a counter. The overall resolution was $\sim 10\%$. Energy distribution was measured for

$(H_\rho) = 1\,710$, 2 060, 2 400 gauss cm with Al foils and for some of these energies with Au, Ag, Ni, collodion and $(CN)_x$. With sufficiently thin foils no evidence of energy loss was obtained, except that for the smaller Z values the thickness was never made small enough for purely single nuclear scattering. The theoretical energy loss due to Bremsstrahlung would not have been observable. Absolute scattering cross-sections could not be measured, but the Z dependence showed better agreement with the Sexl and Urban formula [Abstr. 2325 (1933) and 1128 (1944)] than with Mott's. The results for Au differ remarkably from those predicted by the theory of Abstr. 1472 (1949). J. C. E. J.

537.533.74

7072. Polarization of electrons. SHINOHARA, K. AND RYU, N. Letter in *Phys. Rev.*, **75**, 1762 (*June* 1, 1949).—Measures the polarization of high energy electrons (45 to 92 keV) obtained by scattering at a Au foil of thickness 5×10^{-6} cm inclined at 45° to the beam. A similar foil (at 90°) is used as an "analyser" and the intensity of scattering is measured in various directions by two interchangeable Geiger counters. Good agreement with theory is obtained. J. T.

537.533.74

7073. Experiments on the effect of gas scattering on betatron output. WATSON, H. H. H. *Proc. Phys. Soc., Lond. B*, **62**, 206–8 (*March* 1, 1949).—The X-ray output of a 4 MeV betatron (using a 30 MeV synchrotron magnet) was measured as a function of acceleration time t (msec), gas pressure P ($m\mu$ Hg) and injection voltage V(kV). The results fit the empirical relations $I = I_0 \exp(-1{\cdot}1PtV^{-\frac{1}{2}})$ for air, $I = I_0 \exp(-0{\cdot}09PtV^{-\frac{1}{2}})$ for H. T. G. P.

537.533.74 : 539.18

7074. The Compton scattering by particles possessing charge and dipole moment. SHANMUGADHASAN, S. *Proc. Camb. Phil. Soc.*, **45** (*Pt* 3) 411–28 (1949).—The wave equation derived from the classical equations of a particle with spin, described by two numbers k, l, contains explicit spin interaction terms, in contrast to the Dirac equation. Using this equation, the Compton scattering is calculated either with an unquantized radiation field or using Dirac's scheme of second quantization. The result depends on the particle charge e, dipole moment C and (k, l). Definite values are reported over a range of energies and with angular distribution for particles of spin $\frac{1}{2}$ and 1 for various values of C, and in particular with values corresponding to an electron, proton or neutron. G. J. K.

537.533.8

7075. Absorption of secondary electrons emitted from solids during their movement to the surface. HACHENBERG, O. *Ann. Phys., Lpz.* (*Folge* 6) **2** (*Nos* 7–8) 404–16 (1948) *In German.*—Processes taking the part in the absorption are—collisions due to thermal oscillation in the lattice, collisions with lattice defects, collisions with free electrons and collisions with bound electrons. The relaxation distance S in which the initial energy is reduced by a factor of e is calculated for each process. The effect of the absorption on the observed emission is discussed and it is found that $\delta \propto S$. A comparison with experimental results is made. For sufficiently high bombarding energy the theory predicts for insulators that $\delta \propto T^{-1}$. KCl shows such a relation for $V_0 > 1$ kV. The theory accounts in a general way for the high δ of many insulators. A. H. W. B.

537.533.8 : 621.385.15

7076. Secondary electron emission. MCKAY, K. G. *Adv. Electronics*, **1**, 66–130 (1948).—Work reported since the publication of Kollath's review [*Phys. Z.*, **38**, 202 (1936)] is summarized and discussed. Only secondary emission induced by electron bombardment is dealt with, and technical applications of secondary emission are not included. The survey is divided into pure metals; insulators; composite surfaces. The bibliography of 260 items contains a reasonably complete list of secondary emission publications since 1936, arranged by years.

537.534

7077. Application to mass spectrography of a homogeneous magnetic field with circular boundaries. SPIGHEL, M. *J. Phys. Radium*, **10**, 207–12 (*June*, 1949) *In French.*—This proposal is an advance on the instruments of Bainbridge, Jordan and Mattauch, since it is shown how the curvatures of the entrance and exit faces may be so chosen as to make the mass-dispersion linear and simultaneously to suppress, in the transverse aberration, the quadratic term in angular aperture. Since the effects of fringing field are neglected, calculations are not carried beyond the second order. The increased gathering power due to suppression of quadratic aberration should make short exposure times possible, thus diminishing the probability of considerable fluctuations of accelerating potential during exposure; recent advances in stabilization technique should have a similar effect. Consequently it should be possible to dispense with velocity-focusing altogether, without loss of resolution or gathering power. It is hoped that, by forming an intermediate demagnified image of the source-slit (using an e.s. lens), the reduction of resolving power due to the finite widths of the slit could be avoided. J. C. E. J.

537.534

7078. Comparative survey of ion guns. I–III. HOYAUX, M. AND DUJARDIN, I. *Nucleonics*, **4**, 7–9 (*May*); 12–29 (*June*); **5**, 67–71 (*July*, 1949).—It is stated that the requirements of a good ion source are: large ion current, focused into a narrow beam; high percentage of some desired type of ions; low gas and power consumption; production of monokinetic ions. Ion sources described in the literature are reviewed in the light of these desiderata. They are classified under the following heads: (1) canal ray; (2) low voltage capillary arc; (3) focused electron beam (involving collision of such a beam with a jet of atoms moving parallel or perpendicular to it. This class includes sources in which electrons oscillate under combined steady electric and magnetic fields); (4) high-frequency. Classes 3 and 4 are regarded as the most desirable. The requirements of sources for mass spectrographs and cyclotrons are discussed separately. (86 refs., classified according to type of source.) Problems of beam measurement (suppression of secondary electrons at the target), regulation of gas flow, magnetic analysis of ions and ion focusing are briefly considered. A. P. F.

537.534

7079. Time-of-flight mass spectrometer with varying field. HIPPLE, J. A. AND THOMAS, H. A. Letter in *Phys. Rev.*, **75**, 1616 (*May* 15, 1949).—It is proposed to measure the time-of-flight of ions in crossed uniform magnetic and electric fields, the electric field decreasing linearly with time from $+E_0$ to $-E_0$. In a suitable co-ordinate system the ion paths are circular with a time per revolution $T_1 = 670\,M/H\ \mu$sec [see Abstr. 4030 (1949)]. The separation between source and receiver is small and E is so adjusted that a reference mass M_0 is collected after an integral number of cycles n_0; all other ions making an integral number of cycles will be almost perfectly focused. For mass M, the corresponding number n (which in general will not be integral) is obtained by comparing times of flight of M_0, M, and from an approximately known value of M. Possible advantages, resulting from changes in the time-variation of E, are discussed. T. G. P.

537.534 : 539.155.2 : 545.827

7080. Modern mass spectroscopy. INGHRAM, M. G. *Adv. Electronics*, **1**, 219–68 (1948).—A review article of an introductory nature, divided into: general theory; apparatus; uses of the mass spectroscope; commercially available mass spectrometers. The most important types of (*a*) mass spectroscopes, (*b*) ion sources, (*c*) ion detectors are listed in tables. (Bibliography of 132 entries.)

537.534 : 539.18 : 621.384.6

7081. Note on the Rochester cyclotron. BARNES, S. W., CLARK, A. F., COLLINS, G. B., OXLEY, C. L., MCCREARY, R. L., PLATT, J. B. AND VAN VOORHEES, S. N. Letter in *Phys. Rev.*, **75**, 983 (*March* 15, 1949).—About 0·1 μA of 240 MeV protons were produced in the 130 in cyclotron; π^+ and π^- mesons were observed in photographic emulsions. A sandwiched Cu-plated zircon rotary condenser modulated the 15 kW r.f. oscillator from 26 to 18 Mc/s to feed the dee, which was shrouded by negatively-biased grids to reduce ion loading. The beam reached 58½ in radius (near $n = 0{\cdot}2$) and was 1 in. in height. T. G. P.

537.534 : 539.181

Focusing electrically neutral particles. *See Abstr.* 7292

537.534 : 621.384.6

7082. Three-dimensional design of synchrotron pole-faces. ROBINSON, C. *Proc. Phys. Soc., Lond. A*, **62**, 592–9 (*Sept.*, 1949).—An analytical method for the design of a synchrotron pole-face is outlined, the method taking full account of the cylindrical symmetry. Relaxation methods are employed to determine the exact size and shape of the lips correcting for fringing, and are also used to give a final check on the characteristics of the magnetic field. Practical examples of these methods are then given. A.

537.534 : 621.384.6 : 621.396.615.17

7083. Pulsed oscillator for f-m cyclotron. BURKIG, J. W., HUBBARD, E. L. AND MACKENZIE, K. R. Note in *Rev. Sci. Instrum.*, **20**, 135 (*Feb.*, 1949).—The pulsing circuit described allows the cyclotron oscillator to apply "dee" voltage only during the acceleration time. The oscillator grid leak is replaced by a valve which conducts only during the desired part of the f-m cycle (in this case $\sim\frac{1}{4}$ of the cycle), and which is cut off at the end of the acceleration period by the momentary application of a high r.f. voltage from a pickup circuit. A 50% increase in dee voltage is achieved, with ½ the previous plate dissipation. T. G. P.

537.534.74 : 778.3

7084. Distribution of arc-chord differences in scattered particle tracks. SCOTT, W. T. Letter in *Phys. Rev.*, **75**, 1763–5 (*June* 1, 1949).—A fairly large angle of scattering near the middle of a particle track affects the entire measurement of the arc-chord determination unduly [Abstr. 5183 (1949)]. The sum of the squares of successive chord angles, however, will not be greatly affected if one of the angles is large considering a greater number of chords. The arc-chord difference and the sum of the squares of chord angles distribution for 9 and 21 chords are calculated for a constant energy of the particle and plotted against the apparent mass of the particle using 3 average mass values of 200, 330 and 1 837 m_e. The overlap of the curves for the 3 different masses in each graph shows the difficulty of using multiple scattering as an indication of the mass of the particle. The chord angle method can serve to distinguish between protons and mesons in most but not in all cases, but is unreliable for distinguishing meson masses as close as those used in the preparation of the graphs. R. H. H.

537.534.75

7085. Proton range-energy relation. CLARKE, R. L. AND BARTHOLOMEW, G. A. Letter in *Phys. Rev.*, **76**, 146–7 (*July* 1, 1949).—Tracks of monoenergetic proton groups, with energies down to 0·13 ± 0·03 MeV, were examined in a cloud chamber containing various fillings, including D_2, D_2O, CH_4 and He. The proton ranges were reduced to equivalent lengths in air at S.T.P. using the differential stopping powers of Blackett and Lees. The lowest energy groups came from $H^2(\gamma, n)H^1$ reactions with Ga^{72}, ThC″ and Na^{24} gammas, a value of 2·237 ± 0·005 MeV being adopted for the deuteron binding energy, in estimating the proton energies. Higher energy protons (0·60 MeV) were obtained by the $N^{14}(n, p)C^{14}$ reaction, while other measurements were made on $H^2(d, n)$ and $Li^6(n, \alpha)$ tritons and the ranges of the equivalent protons deduced. The data obtained was in good agreement with the curve of Livingston and Bethe. L. R. S.

DISCHARGE TUBES . COUNTERS 537.54

537.542

7086. A new ion source for mass spectrometry. BARNARD, G. P. Letter in *Nature, Lond.*, **164**, 283–5 (*Aug.* 13, 1949).—A source of the constant velocity, direction-focused type, using crossed electric and magnetic fields is described, with diagrams. The full length of the filament is exposed and its emission is grid controlled. Grid control enables the electron beam to be focused in a trochoidal path (one loop is used) without slits, in a uniform magnetic field of

25–30 gauss parallel to the filament and to the ion slits. The anode potential is adjusted to bring the electron beam close to the gas slot. Advantages claimed over sources commonly used are: (1) the smaller magnetic field reduces mass discrimination, (2) centring fields in the gun are not required, (3) > 99% of the filament emission is effective for ionization thus increasing sensitivity (possibly by a factor 10), (4) spread in ion energy is only 1 or 2 V. T. G. P.

537.542

7087. On the efficiency of gas counters filled with carbon dioxide and carbon disulphide. HAWKINGS, R. C., HUNTER, R. F. AND MANN, W. B. *Canad. J. Res. B*, **27**, 555–64 (*June*, 1949).—The efficiencies of compensated gas counters filled with CO_2 and CS_2 have been investigated for the purpose of determining absolute disintegration rates of $C^{14}O_2$ samples. In addition to comparing compensated counting units of different radii, a special counter has been constructed to determine the efficiency at different radii using a collimated beam of electrons from Tl^{204}. The CO_2 and CS_2 filled counters have been shown to be at least 97% efficient. A.

537.542

7088. Spurious counts in Geiger counters and the pre-treatment of the electrodes. LOUW, J. D. AND NAUDÉ, S. M. Letter in *Phys. Rev.*, **76**, 571–2 (*Aug.* 15, 1949).—Discusses the possible bearing of the nature of cathode surfaces on the frequency of spurious counts (delayed emission of electrons, etc.). Experiments were carried out with a point counter using a Pt point and various metal surfaces (Pb, Fe, Al and brass), with an A/alcohol filling. Appreciable activities, decaying with time according to the metal and its treatment, were found, together with effects, i.e. increases in counting rates, due to heating. J. D. C.

537.542

7089. On the temperature dependence of counter characteristics in self-quenching G-M counters. PARKASH, O. Letter in *Phys. Rev.*, **76**, 568–9 (*Aug.* 15, 1949).—Describes plateau measurements made at temps. varying between 8° and 60°c with two counters: (i) a conventional tube containing 8·5 cm A and 1·5 cm alcohol vapour, and (ii) an external cathode counter (graphite on glass cathode). Tube (i) showed poor plateaus at 9–16° and satisfactory results at higher temps., whilst tube (ii) showed better plateaus at 9° than at 23° with some deterioration at higher temps. The results are discussed; the importance of leakage paths, giving spurious counts, for tube (i) is suggested. J. D. C.

537.542

7090. On Geiger–Müller counters with external cathodes. BLANC, D. AND SCHÉRER, M. *C.R. Acad. Sci., Paris*, **228**, 2018–20 (*June* 27, 1949) *In French.*—Geiger counters consisting of glass cylinders coated externally with graphite are described. The effect of guard-rings, which also consist of graphite coatings on the glass, is shown to be very beneficial in improving the linearity of the relation between sensitivity and cathode length. These relations are exhibited graphically. J. D. C.

537.542

7091. Rejuvenation of Geiger–Mueller tubes. SHEPARD, L. Note in *Rev. Sci. Instrum.*, **20**, 217–18 (*March*, 1949).—Rejuvenation of Geiger–Mueller tubes filled with A/ethanol is not complete if the filling is renewed, but is virtually so if the W centre wire is heated electrically for about 10 min to dull redness. This treatment was successful in 49 out of 52 cases. J. D. C.

537.542

7092. Octane vapour proportional counter. PEPPER, T. P. Note in *Rev. Sci. Instrum.*, **20**, 222–3 (*March*, 1949).—Describes the use of pure *n*-octane vapour in a proportional counter for the study of the yields from D(*d*, *p*)T and D(*d*, *n*)He^3. The pulse distribution, taken with a 30-channel pulse recorder, and showing clearly the T and He^3 peaks is reproduced. A brief discussion of the advantages of this method, and 6 suitable vapours, is given. J. D. C.

537.542

7093. Construction of beta-Geiger counters from prefabricated thin wall tubing. SENFTLE, F. E., HAVERCROFT, W. AND HERNANDEZ, P. *Rev. Sci. Instrum.*, **20**, 370–1 (*May*, 1949).—Describes the new Corning thin wall (0·006 to 0·016 in) borosilicate glass tubing and the technique of constructing Geiger tubes from it. The tubes, of o.d. 19 or 25 mm, will withstand external pressures of 60 lb/in², and are available in 6 or 8 in lengths. J. D. C.

537.542 : 621.385.1

7094. Geiger counter tubes. FRIEDMAN, H. *Proc. Inst. Radio Engrs*, **37**, 791–808 (*July*, 1949).—A review of existing theories and methods of constructing tubes to obtain max. counting efficiencies and other desirable characteristics, such as low threshold voltage, thermal insensitivity, long life, high resolution and low background. A selective bibliography of 69 items is included. A.

537.542 : 539.172.4

7095. Modified ionization chamber for study of angular distribution of ionizing particles. RAMANNA, R. AND CHAMPION, F. C. Letter in *Nature, Lond.*, **164**, 226–7 (*Aug.* 6, 1949).—U_3O_8 was coated on the inside of the positive plate of an A-filled, parallel plate ion chamber. Negative ions produced by fission fragments are collected first, due to their greater mobility, and the resulting pulse triggers a c.r.t. time base, the positive ion pulse being applied to the Y plates. The position of the positive ion pulse on the screen is determined by the projected length of the fission fragment track in the direction of the electric field, while the pulse height determines the total track length. The angle between track and field is thus determined with a resolution of 10° for angles >25°. Measurements made in a beam of Ra–Be neutrons indicated an isotropic distribution. L. R. S.

537.542

7096. Electron collection in high pressure methane ionization chambers. BEGHIAN, L. E. AND HALBAN, H. H. Letter in *Proc. Phys. Soc., Lond. A*, **62**, 395–6 (*June* 1, 1949).—Describes work with high-pressure ionization chambers filled with carefully purified CH_4 which enables electron collection to be operative. At 35 atmos. the efficiency of counting 2·3 MeV

neutrons (D + D source) was about 12% and the electron collection time was about 0·7 μsec. J. D. C.

537.542

7097. On the pulse shapes obtained with ionization chambers. BILLAUD, P. *C.R. Acad. Sci., Paris*, **228**, 1212–14 (*April* 4, 1949) *In French.*—It is shown how to calculate the pulse size obtained with an ionization chamber and amplifier of time constant ⩾ the mean life of the particles producing the pulse, in terms of the various practical parameters. Electron collection is also briefly discussed. J. D. C.

537.542

7098. The physical foundations of crystal counters. STÖCKMANN, F. *Naturwiss.*, **36** (*No.* 3) 82–6 (1949) *In German.*—A descriptive account is given of the mechanism of production of an electrical impulse in an insulating crystal, subjected to an electrostatic field, and irradiated in a suitable manner. The case of ZnS is especially considered. Next, the use of various crystals, e.g. AgCl, as counters is discussed and a final section deals in detail with CdS. J. D. C.

537.542

7099. Detection of ionizing particles by crystals of sulphur. GEORGESCO, M. *C.R. Acad. Sci., Paris*, **228**, 383–5 (*Jan.* 31, 1949) *In French.*—For AgCl the ionization energy required to raise an electron into a conduction band is 7·5 eV (method of Wasastjerna, Soc. Scient. Fennica [*Comm. Phys.-Math.*, **8**, 21 (1936)]), compared with 7·3 eV by experiment. Values calculated for other insulators showed the best to be S (5 eV); using S as a crystal counter, values of this order of magnitude were obtained, and all of 14 crystals counted α-particles, 3 of them counted β-particles. The pulse amp. is ∝ the energy absorbed in the crystal and the counter is directional. It can be used at room temp. A. O. S.

537.542

7100. Cadmium sulphide as a crystal counter. GOLDSMITH, G. J. AND LARK-HOROVITZ, K. Letter in *Phys. Rev.*, **75**, 526–7 (*Feb.* 1, 1949).—Describes the use of CdS for counting Po α's, RaE β's, and Ra, MsTh and Co^{60} γ's. A linear amplifier having a gain of about 3 500 at a rise time of 0·2 μsec was used. A few exptl. details and photographs of pulses, as displayed on a c.r.o. screen, are given. J. D. C.

537.542

7101. Crystal counters. II. HOFSTADTER, R. *Nucleonics*, **4**, 29–43 (*May*, 1949).—The determination of electron mobility in a crystal by observation of the rise-time of an ionization pulse with a given electric field is discussed. Measured values of mobility may approach the theoretical ones, although in general they are considerably lower. Evidence is quoted to show that the energy per ion pair (as found from pulse size due to β-particles of known energy) may be as low as ∼6 eV in AgBr, thus aiding detection of low energy particles. Polarization effects are shown to limit rather severely the usefulness of crystals as counters. It is suggested that mosaic structure disqualifies a crystal as a counter by limiting the electron path to $\sim 10^{-4}$ cm and thus reducing the induction pulse below amplifier noise level; a "perfect" crystal may, however, fail for other reasons. Advantages claimed for the crystal counter are: (*a*) proportionality of pulse size to β-particle energy up to high energies; (*b*) high efficiency in detecting high energy quanta (it is stated that a large crystal could be used to stop a 100 MeV γ-ray and all the products of its interaction with matter). The resolving time is > that obtained with scintillation counters, but < that of gas-filled detectors. The desirability of finding a crystal that does not need to be cooled (and therefore surrounded with scattering material) is emphasized. [See Abstr. 5491 (1949)]. A. P. F.

537.542

7102. Measurement of particle energies with scintillation counters. GARLICK, G. F. J. AND FATEHALLY, R. A. Letter in *Phys. Rev.*, **75**, 1446 (*May* 1, 1949).—Fairly uniform output pulses were obtained for α-particles of a given energy, with natural transparent scheelite crystals used in conjunction with Sb–Cs cathode photomultipliers. Similar results were obtained with naphthalene activated by anthracene or stilbene. Average pulse height is approximately ∝ incident particle energy. Pulses from naphthalene–stilbene crystals were about twice as large as those from naphthalene-anthracene. In these and various other phosphors, there was no marked difference in pulse heights due to α particles and γ-rays of equivalent energies. L. R. S.

537.542

7103. Suggested slow neutron crystal counter. YAMAKAWA, K. A. Letter in *Phys. Rev.*, **75**, 1774 (*June* 1, 1949).—A single mixed Li and AgBr crystal, 0·75 cm thick × 1·2 cm^2 area, cooled to liquid N temp., was used to record thermal neutrons by the $Li^6(n, \alpha)H^3$ reaction, with an applied field of 2 700 V/cm across the crystal. The max. pulse heights, due to neutrons from a Ra–Be source in paraffin, were found to be ⩾ the max. height of pulses produced from a separate Ra γ-source and it is inferred that the energy of heavy particles (H^3 and He^4) required to produce each ion pair in the crystal ⩾ twice that for electrons. The crystal which contained 4 Ag atoms per Li atom had a counting efficiency of 5% for thermal neutrons. L. R. S.

537.542

7104. A search for crystals that exhibit conduction pulses under alpha-particle bombardment. AHEARN, A. J. Letter in *Phys. Rev.*, **75**, 1966–7 (*June* 15, 1949).—The investigation was carried out on flat plates, mostly single crystals of naturally occurring minerals. In addition to diamond, wurzite, cinnabar, stibnite and carborundum were found to show some response. A list of minerals which were found to be inactive is also given. H. K. H.

537.542 : 539.164

7105. Scintillations produced by α-particles in a series of structurally related organic crystals. KOSKI, W. S. AND THOMAS, C. O. Letter in *Phys. Rev.*, **76**, 308–9 (*July* 15, 1949).—An interim report stating that diphenylacetylene is about 6 times better than the best previously reported materials [stilbene—see Abstr. 1958 (1949)] in terms of photons produced per unit α-particle energy loss. Briefly discusses crystal structure and counting efficiency. L. E. M.

537.542

7106. Removal of space-charge in diamond crystal counters. CHYNOWETH, A. G. Letter in *Phys. Rev.*, **76**, 310 (*July* 15, 1949).—The crystal was irradiated with a suitable intensity of light from a Nernst lamp. This satisfactorily removed the space-charge set up (with consequent decrease in pulse size) during α-particle counting. L. E. M.

IONIZATION . THERMIONICS 537.56/.58

537.56 : 621.317.728

7107. Use of radioactive cobalt for sphere gap irradiation. HARDY, D. R. AND CRAGGS, J. D. Letter in *Nature, Lond.*, **164**, 356–7 (*Aug.* 27, 1949).—The need for the production of initial electrons, in spark gaps used to measure impulse voltages, is stressed. Ionization currents in air at 1 atm. pressure were measured with an electrode machined out in Co and irradiated in one of the Harwell piles. Results are given graphically. J. D. C.

537.563

7108. Researches on heavy ions in gases. VASSAILS, G. *Ann. Phys., Paris* (*Sér.* 12) **4**, 125–217 (*March–April*, 1949) *In French.*—A comprehensive study was made of the *increasing* conductivity acquired by air *after* being traversed by a beam of ultra-violet light: it was established that the cause was the presence of heavy ion clusters, and the investigations covered their production, charge, mobility, dimensions and nature. A detailed account is given of a new technique of determining heavy ion mobilities, based on the rate of deflection of a quadrant electrometer connected to a large cylindrical ionization chamber. It was shown that the passage of an ionizing beam (whether natural or from radioactive bodies) produced a precipitation of an aerosol—a cloud of neutral and ionic clusters in suspension—of which the neutral particles became transformed into heavy ions by capture of molecular ions. This progressive electrification was studied in terms of the relevant parameters. The method of determining ionic mobilities developed was applied to the heavy ions produced by the action of u.v. light in air. An observed succession of discontinuous values of the rate of electrometer deflection was taken to indicate the transport by the same particle of various small numbers of elementary charges. The particle was visible in an ultra-microscope. The phenomena obtained with u.v. light could also be obtained with other ionizing radiations. A relation was derived between the behaviour of a liquid and the permanent molecular moment. In investigating the nature and method of production of the heavy ions, the influence of the wavelength of the ionizing radiation, the chemical changes which always accompanied the appearance of the clusters, and the influence of volatile impurities were all examined, and it was concluded that there was probably a photo-chemical origin to the production of the heavy ions. F. LL. J.

537.563

7109. Dissociation and ionization of *n*-hexane, cyclohexane and benzene by electron impacts. I. KAMBARA, T. *J. Phys. Soc. Japan*, **2**, 25–31 (*May–June*, 1947) *In English.*—Experiments were made with a mass-spectrograph to analyse ions formed by electron impact in organic vapours, and data obtained on their molecular structure and dissociation processes are discussed. F. LL. J.

537.563

7110. Dissociation and ionization of *n*-hexane, cyclohexane and benzene by electron impacts. II. KAMBARA, T. *J. Phys. Soc. Japan*, **2**, 57–62 (*July–Aug.*, 1947) *In English.*—See preceding Abstr. Difference between hydrocarbons of straight chain type like *n*-hexane and ring type like benzene is considered and the relation between their stability and anti-knocking tendencies discussed. F. LL. J.

537.563

7111. Decomposition of chain hydrocarbons by electron impact. VIALLARD, R. AND MAGAT, M. *C.R. Acad. Sci., Paris*, **228**, 118–20 (*March* 28, 1949) *In French.*—Analysis of mass-spectrographic data for ionizing electron energies of 50 eV to 100 eV published by the National Bureau of Standards, can give information about the nature of radicals, neutral and ionized, and the rules for their production by electron impact: those which apply particularly to chain type hydrocarbon molecules are briefly given. F. LL. J.

537.565 : 536.423.4

Charge on nuclei from hot platinum. *See Abstr.* 6957

537.581 : 535.215.4

7112. Photoelectric and thermionic properties of nickel. CARDWELL, A. B. *Phys. Rev.*, **76**, 125–7 (*July* 1, 1949).—The photoelectric and thermionic properties of spectroscopically pure Ni were studied through a wide range of temps., including the Curie temp., 350°C. The samples were studied after having been subjected to long outgassing processes. A marked change occurs in the slope of the temp.-photoelectric current curves at the Curie temp. This change is accounted for by an increase in the work function and a change in the probability factor α. The work function of carefully outgassed Ni was found to be $5{\cdot}05 \pm 0{\cdot}05$ eV below 623°K. At this temp. the work function increases, becoming $5{\cdot}20 \pm 0{\cdot}05$ eV at 1 107°K. A work function of 5·24 eV was determined thermionically at temps. of 1 150°K and above. A.

537.583 : 621.385.032.216

7113. D.c. and pulsed emission from oxide cathodes. WRIGHT, D. A. Letter in *Proc. Phys. Soc. B*, **62**, 398–400 (*June*, 1949).—The difference between pulsed and d.c. emission from oxide cathodes is due to a decay which causes the d.c. emission to be < instantaneous (or pulsed) emission. That the decay is due to a "poisoning" effect which lowers the d.c. emission but not the pulsed emission, is shown by experimental evidence. The interpretation and implications of these observations are discussed. T. E. (R)

537.583 : 621.385.032.216

7114. Oxide coated cathodes. EISENSTEIN, A. S. *Adv. Electronics*, **1**, 1–64 (1948).—This review discusses in detail some of the more recent research, and

re-examines earlier work to ascertain whether the experimental results are consistent with the modern theory of semi-conductors. New experiments are suggested which may lead to a more complete understanding of the phenomena. Main sections: properties of the coating; properties of the interface; properties of the complete cathode; thin oxide film phenomena. Bibliography of 89 items, the majority later than 1939.

537.583 : 621.385.032.216

7115. Pulse emission decay phenomena in oxide-coated cathodes. FEASTER, G. R. Letter in *J. Appl. Phys.*, **20**, 415–16 (*April*, 1949).—Expresses the view that the short time decay ($< 10\ \mu$sec) of emission in oxide cathodes is not fundamental but is an anomaly due to poisoning. Tubes which normally showed no decay showed it when the anode was coated with NaCl or NaF. The effect of oxygen has not yet been determined. A. H. W. B.

537.583 : 621.385.032.216

7116. Note on volt-dependent poisoning effects in oxide-cathode valves. METSON, G. H. *Proc. Phys. Soc., Lond.B*, **62**, 589–92 (*Sept.*, 1949).—The high-vacuum oxide-cathode valve may show cathode poisoning effects when its electrodes are bombarded by electrons of certain discrete energies. Hamaker, Bruining and Aten describe one such effect occurring at about 10 eV. The author confirms this result and describes two other effects occurring at 5·56 eV and 15·9 eV. The energies of the 3 effects can be closely associated with the heats of formation of the chlorides, monoxides and sulphates of Ba and Sr. It is concluded that the 5·56 eV effect is due to bombardment dissociation of the monoxides of Ba or Sr, the 10 eV effect to the chlorides and the 15·9 eV effect either to the sulphates or to a gaseous ionization phenomenon. A.

COSMIC RAYS 537.591

537.591.08

7117. A cosmic ray radio sonde. THATTE, R. P. *J. Sci. Industr. Res.*, **8**, 259–70 (*July*, 1949).—Using radio sonde technique, cosmic-ray vertical intensity up to 40 000 ft was recently measured at New Delhi. The radio sonde equipment used in these flights is described. It consists of the coincidence unit with a pulse lengthening circuit; a meteorograph for the pressure-temp. data; and two u.h.f. light-weight transmitters to transmit the two data separately. The receiving unit consists of a super-regenerative receiver coupled to a neon-coupled amplifier feeding a high-speed tape recorder for each of the channels. Using Indian-made balloons, heights of 40 000 ft were consistently reached, though the weight of the equipment was about 22 kg. In one flight, 10 cm Pb absorber was used, the total weight then being 30 kg, yet the flight reached a height of 60 000 ft. A.

537.591.1

7118. The flux of heavy nuclei of the primary cosmic radiation at geomagnetic latitudes $\lambda = 55°$ and $\lambda = 30°$. BRADT, H. L. AND PETERS, B. Letter in *Phys. Rev.*, **76**, 156–7 (*July* 1, 1949).—The energy spectrum of the heavy primaries is reported for $\lambda = 55°$, and the flux for $\lambda = 30°$ and 55°, from observations on nuclear plates flown for several hours at ~ 100 000 ft. The latitude effect was ~ 1·5, showing that the majority of the heavy primaries have energies of several BeV per nucleon. At $\lambda = 30°$ N, only 70% of the primary nucleons can be protons, about 30% (15% neutrons) being contained in the component of nuclei with $Z = 2$ to $Z = 26$. E. P. G.

537.591.1

7119. Magnetic deflection of cosmic-ray mesons using nuclear plates. BARBOUR, I. Letter in *Phys. Rev.*, **76**, 320–1 (*July* 15, 1949).—Two nuclear plates were exposed with an air gap separating their parallel emulsion surfaces in a permanent magnetic field of 13 300 gauss, for periods of 1 and 3 hr at 90 000 ft. Mass and charge measurements are reported for 33 mesons of types π, σ, μ and ρ. No evidence was found for the presence of τ-mesons. E. P. G.

537.591.1 : 539.18

7120. Investigation of the meson spectrum at sea-level. HÖCKER, K.-H. *Z. Phys.*, **125** (*Nos* 11–12) 780–800 (1949) *In German.*—The description already developed [Abstr. 3377, 3378 (1948)] to describe the cosmic-ray beam in the atmosphere is used to calculate the sea-level energy spectrum of mesons, and is shown to be in agreement with measurements. The positive excess of mesons at sea-level is also considered, and the production of penetrating ionizing particles by uncharged particles. J. G. W.

537.591.15

7121. A probable sidereal variation of large cosmic ray showers. AUGER, P., DAUDIN, J., DENISSE, J. AND DAUDIN, A. *C.R. Acad. Sci., Paris*, **228**, 1116–18 (*March* 28, 1949) *In French.*—Large atmospheric showers were recorded at the Pic du Midi, using 3 counter trays each of area 1 900 cm², with a max. separation of 75 m. The hourly means for the period Aug.–Oct., 1948, are claimed to show a dependence on sidereal time. A galactic source of the shower-primaries is postulated. E. P. G.

537.591.15

7122. The penetration of cascade showers and photons. DAUDIN, J. *C.R. Acad. Sci., Paris*, **228**, 1286–8 (*April* 11, 1949) *In French.*—Pb screens up to 16 cm thick were placed over 2 counters, *a*, which were surrounded by 8 counters, *b*, connected in anti-coincidence. The frequency of the anticoincidences (*a*–8*b*), as a function of the thickness of Pb, were shown to be consistent with the cascade theory as revised by several authors, allowance being made for the enhanced range of the low-energy photons. Since the absorption curve of the Auger showers up to 18 cm of Pb may be explained in terms of electron-photon cascades, the argument in favour of the λ-meson is regarded as having lost its force. E. P. G.

537.591.15

7123. The structure of extensive air showers. SALVINI, G. Letter in *Nuovo Cim.* (*Ser.* 9) **6** (*No.* 4) 300–2 (1949) *In Italian.*—A discussion of a possible mechanism for the production of these showers. L. P.

537.591.15

7124. The density spectrum of extensive air showers at sea level. ADDARIO, M. M. AND MILONE C.

Letter in *Nuovo Cim.* (*Ser.* 9) **6** (*No.* 4) 294–6 (1949) *In Italian.*—Measurements were made for densities up to 10^3 m^{-2}. The exponent γ of the density spectrum $V(\Delta) = K\Delta^{-\gamma}$ was found to be $1{\cdot}50 \pm 0{\cdot}05$, in good agreement with values previously obtained for lower densities. L. P.

537.591.15

7125. Photons in extensive cosmic-ray-showers. CLAY, J. *Proc. K. Ned. Akad. Wet.*, **52** (*No.* 4) 450–6 (1949) *In English.*—By using 4 Geiger counter telescopes arranged in a square, the absorption curve of the particles in extensive showers is studied up to 10 cm Pb. The results are interpreted in terms of a large number of photons. The exponent, γ, in the density spectrum is found to vary from 1·5 for low densities to 3 for high densities. A barometric coefficient of 13% per cm Hg is reported for extensive showers. E. P. G.

537.591.3

7126. Cosmic-ray underground. HAYAKAWA, S. AND TOMONAGA, S. Letter in *Phys. Rev.*, **75**, 1958–9 (*June* 15, 1949).—The interpretation of the change of slope of the absorption curve of cosmic-ray particles at great depths in terms of the restriction of π–μ decay at very high energies is developed in terms of accepted values of primary nucleon absorption coeff., π lifetime, π and μ mass and index of the meson spectrum at formation. It is shown that the observed results require account to be taken of radiation and pair production by μ-mesons, but do not at present distinguish between the absence of absorption of π-mesons in the atmosphere and an absorption as great as that of primary nucleons. J. G. W.

537.591.5 : 523.75

7127. Theory of the negative correlation between the 27-day variation of cosmic radiation and Ca-flocculi character figures. VON ROKA, E. G. *Naturwiss.*, **36** (*No.* 1) 24–5 (1949) *In German.*—The 27-d cosmic-ray intensity variation, exhibiting negative correlation with number of Ca flocculi visible on the solar disc, is explained as a result of temp. changes in the upper portion of the O_3 layer, caused by direct absorption of solar u.-v. radiation. D. R. B.

537.591 : 539.18

7128. Mean life considerations in relation to curvature of cosmic-ray paths in a magnetic field. SWANN, W. F. G. Letter in *Phys. Rev.*, **76**, 157–8 (*July* 1, 1949).—The passage of unstable particles through a magnetic field is considered. The fraction that suffers a given deflection without decay is shown to be independent of energy loss along the path. E. P. G.

537.591.8

7129. On the nature and number of the penetrating particles in nuclear explosions produced in lead by cosmic-rays. LOVATI, A., MURA, A., SALVINI, G. AND TAGLIAFERRI, G. Letter in *Nuovo Cim.* (*Ser.* 9) **6** (*No.* 4) 291–3 (1949) *In Italian.*—The cross-section in Pb for the production of nuclear explosions by particles of penetrating showers was found to be $0{\cdot}9 \pm 0{\cdot}3 \times 10^{-24}$ cm^2. There are indications of a sort of nuclear cascade process in which the average number of particles produced per explosion decreases from about 16 to about 4. L. P.

537.591.8 : 539.18

7130. Addendum: energy spectrum of the decay particles and the mass and spin of the mesotron. LEIGHTON, R. B., ANDERSON, C. D. AND SERIFF, A. J. *Phys. Rev.*, **76**, 159 (*July* 1, 1949).—See Abstr. 4870 (1949).

537.591.8

7131. A large nuclear disintegration produced by a very high energy alpha-particle of the cosmic radiation. LORD, J. J., SCHEIN, M. AND VIDALE, M. Letter in *Phys. Rev.*, **76**, 321 2 (*July* 15, 1949).—Gives details of a star observed in an Eastman NTB-3 photographic plate flown in the stratosphere by free balloons. The primary appears to be an α-particle which suffers a deflection of 2·5° at the collision, and continues on out of the emulsion. The star consists of 8 further ionizing tracks, including 1 π-meson which comes to rest in the emulsion. E. P. G.

537.591.8

7132. Cosmic-ray induced nuclear stars at high altitudes. FREIER, P., NEY, E. P. AND OPPENHEIMER, F. Letter in *Phys. Rev.*, **75**, 1451–2 (*May* 1, 1949).—By maintaining photographic plates at 3 different levels in the upper atmosphere, the star-production in the corresponding regions has been deduced. A strong maximum in the rate of production of small stars, somewhere between 30 000 and 70 000 ft, is reported. Transition effects in the materials of the plates have been observed. E. P. G.

537.591.8

7133. On the origin of high energy photons. HAYAKAWA, S. *Phys. Rev.*, **75**, 1759–60 (*June* 1, 1949).—The difficulties of identifying the origin of the cascade component accompanying some penetrating showers with the decay of neutral mesons of short lifetime are considered, and as an alternative process the purely electromagnetic effects accompanying the sudden stopping or creation of a charged particle are examined. The emitted photon spectrum is limited at high energies by the condition that the collision time must be $\ll$ the period of the photon and at low energies by the possibility of interference between processes at more than one nucleon. The photons are thus essentially of high energy, and the probability of the emission of a photon is small but may be adequate. J. G. W.

537.591.8

7134. On the production of cosmic-ray stars in the stratosphere. LORD, J. J. AND SCHEIN, M. Letter in *Phys. Rev.*, **75**, 1956 (*June* 15, 1949).—Transition curves, for star production in photographic emulsions and for the occurrence of isolated protons, have been measured from balloon exposures at 5 cm Hg pressure up to 46 gm/cm^2 Pb, using plates embedded at various depths in a Pb block. Plates simultaneously exposed in a light gondola 25 ft above the main pile were used to demonstrate the effect of backward projected star-producing particles, which appear to contribute mainly to very small stars. J. G. W.

537.591.8

7135. Intensity of cosmic-ray stars and slow mesons in the stratosphere. LORD, J. J. AND SCHEIN, M.

Letter in *Phys. Rev.*, **75**, 1956–7 (*June* 15, 1949).—Flights in which free balloons spend many hours at substantially constant pressure have been used to deduce the intensity of star-producing radiation at pressure levels, 1·1, 3·2, 5·0 and 5·8 cm Hg. The absorption coeff. of the star-producing radiation is given as 148 g/cm.² J. G. W.

537.591.8 : 523.72

7136. Relations between solar radio emissions and cosmic rays. DENISSE, J.-F. *C.R. Acad. Sci., Paris*, **228**, 467–9 (*Feb.* 7, 1949) *In French.*—An apparent connection is revealed between cosmic-ray intensity in the high atmosphere (balloon-sonde ascents) and solar temp. derived from radio "noise" measures at $\lambda = 10$ m. High values of cosmic-ray intensity are associated with exceptional outbursts of solar noise, and brilliant chromospheric eruptions. To explain this, it is supposed that the cosmic radiation incident on the high atmosphere is composed of: (i) a soft component of variable magnitude, and solar origin, strongly absorbed by the lower atmosphere; and (ii) a hard component, constant in time, and able to penetrate to sea-level. Such an assumption will fit the observation that no such connection is found for cosmic-ray intensities measured at sea-level. D. R. B.

537.591.8 : 539.18

7137. Photograph of a shower produced by a π-meson, and a π-μ-decay. SINHA, M. S. *Phys. Rev.*, **75**, 1757–9 (*June* 1, 1949).

MAGNETISM 538

538.082.103 : 621.317.443

7138. Study of [magnetic] metals in permeameters with demountable coils. EPELBOIM, I., MARAIS, A. AND PANNETIER, P. *Rev. Métall.*, **46**, 315–18 (*May*, 1949) *In French.*—Prefabricated toroidal windings carrying up to 40 turns are described. They are considered suitable for measurements of magnetic properties on annular cores up to 60 Mc/s. Their use is exemplified by a study of the variation of eddy loss component with thickness in material from which the outer layers are progressively removed by electrolytic polishing. N. F. A.

538.082.743

7139. On the measurement of magnetic permeability at ultra-high frequencies. SOUTIF-GUICHERD, J. AND GRIVET, P. *C.R. Acad. Sci., Paris*, **228**, 1796–7 (*June* 8, 1949) *In French.*—Permeability can be deduced from measurements of resonance curves on a coaxial line. Measurements have been made at 3 cm on ferro-nickel wire 0·5 mm dia., variations in the permeability being obtained by application of a field of a few hundred oersted to the inner conductor. It has been verified that the Q-factor varies inversely as the square-root of the permeability. G. F. H.

538.11 : 530.145.63

7140. Note on Dirac's theory of magnetic poles. SAHA, M. N. Letter in *Phys. Rev.*, **75**, 1968 (*June* 15, 1949).—A simple method for finding the value of Dirac's simple magnetic poles [Abstr. 1703 (1949)] was given by the author in 1936 [Abstr. 2862 (1936)]. G. J. K.

538.114

7141. Ferromagnetic resonance in iron oxides. CROUCH, G. E. Letter in *Phys. Rev.*, **75**, 525–6 (*Feb.* 1, 1949).—It is suggested that the broad regions of ferromagnetic resonance observed in Fe_3O_4 and γ Fe_2O_3 are due to the interaction of magnetic dipoles to affect the value of the internal magnetic field about which there is spin precession. A. E. DE B.

538.114

7142. Erratum and addendum: Domain interactions in the theory of ferromagnetic resonance. RADO, G. T. Letter in *Phys. Rev.*, **75**, 1451 (*May* 1, 1949).—See Abstr. 3326 (1949).

538.114

7143. Crystal interactions in ferromagnetic resonance. BROWN, W. F., JR. Letter in *Phys. Rev.*, **75**, 1959–60 (*June* 15, 1949).—Reference is made to recent attempts by Rado [see Abstr. 3326 (1949)] to correct for magnetic interactions between crystal grains in the theory of ferromagnetic resonance, and an outline is given of a direct treatment of the problem. In general, interaction can occur but the order of magnitude could only be estimated by calculations for special cases, e.g. plane parallel crystal boundaries or isolated spherical inclusions. G. F. H.

538.214

7144. Significance of magnetic measurements in determination of constitution of dia- and paramagnetic alloys. MAHN, F. *Rev. Métall.*, **46**, 363–4 (*June* 1949) *In French.*—Variations in susceptibility are related to composition for Pb–Tl alloys. N. F. A.

538.22

7145. Antiferromagnetism of NiO. FOËX, M. AND LA BLANCHETAIS, C. H. *C.R. Acad. Sci., Paris*, **228**, 1579–80 (*May* 16, 1949) *In French.*—Anomalous expansion occurs in MnO, FeO, CoO and NiO, the first 3 of which are also known to be antiferromagnetic. High purity samples of NiO were investigated for the variation with temp. of the susceptibility at various constant field-strengths. The curves display a max. at 374°C and a point of inflection at a temp. near that at which anomalous expansion occurs. It is concluded that NiO also is antiferromagnetic. C. E. W.

538.221

7146. Measurement of gyromagnetic constant of Fe and Ni. MEYER, A. J.-P. *C.R. Acad. Sci., Paris*, **228**, 1934–5 (*June* 20, 1949) *In French.*—Careful measurement shows that the Landé factor for Fe and Ni differs from 2 by only a few parts in a thousand. N. F. A.

538.221

7147. Magnetic properties of ferromagnetic powders: MnBi. GUILLAUD, C. *J. Rech. Cent. Nat. Rech. Sci.* (*No.* 9) 267–78 (1949) *In French.*—Properties of MnBi powders are reported. Grain sizes range from 3–100 μ. Results are discussed in terms of magneto-crystalline energy and self-demagnetizing field of the particles.

538.221

7148. Tentative explanation of magnetic properties of rhombohedral iron sesquioxide. NÉEL, L. *Ann. Phys., Paris* (*Sér.* 12) **4**, 249–68 (*May–June*, 1949) *In French.*—Cubic Fe_2O_3 (γ) approaches magnetite in its properties; rhombohedral Fe_2O_3 (α), however, has a very high coercive force and very low saturation. It is suggested that the properties of Fe_2O_3 α are due to the superposition of feeble ferromagnetism upon anti-ferromagnetism, the latter being a characteristic property of pure Fe_2O_3. The feeble ferromagnetism could arise from traces of Fe_3O_4 precipitated during cooling as an intermediate phase, probably basically hexagonal, a structure related to and derived from that of atoms in planes normal to the ternary axis of ordinary magnetite. Effects of particle size and the thermomagnetic behaviour are discussed. N. F. A.

538.221 : 621.318.22

7149. Relations between the magnetic characteristics of macroheterogeneous magnetically-hard systems. ALTMAN, A. B., KAZARNOVSKIĬ, L. SH. AND MEMELOV, V. L. *J. Tech. Phys., USSR*, **19**, 560–6 (*May*, 1949) *In Russian.*—The investigation was connected with the Fe–Ni–Al alloy permanent magnets produced by powder metallurgy. Systems of this kind, consisting of (1) a magnetically hard and a non-magnetic phase, (2) a hard and soft phase, (3) two different hard phases, were investigated. Remanent flux density B_r and coercive force H_c were measured as functions of the phase composition (quantity ratio of phases). It was found that the increase of the concentration of the non-magnetic phase, while reducing the remanent magnetism, does not alter the coercive force, whereas in the hard-soft mixed system the increase of the soft phase reduces both B_r and H_c. A direct proportionality between phase-relation and B_r was found to exist in the mixture of 2 hard materials; the coercive force decreases with increasing content of the phase of lower H_c, but does not follow a linear law. B. F. K.

538.221 : 621.318.22

7150. Magnetic alloys with high constancy of permeability. SIXTUS, K. *Phys. Bl.*, **5** (*No.* 2) 64–5 (1949) *In German.*—After brief mention of magnetic materials previously found to have markedly constant initial permeability ("Nicalloy 400," perminvar, etc.) new materials in this class are described having a low Ni content. For an Fe alloy with 3% Si and 5% Ni quenching from the m.p. gave a coercivity of 3·8 oersted and a relative change of μ_0 (for a change of field from 0·02 to 0·1 oersted) of 20/400. For another, specially pure, alloy after slow cooling the relative change was 75/800. The magnetic properties are ascribed to the presence of two phases, giving rise to fluctuations in composition determined by the cooling speed. E. P. W.

538.222

7151. Paramagnetic anisotropy of manganous fluoride. STOUT, J. W. AND GRIFFEL, M. Letter in *Phys. Rev.*, **76**, 144 (*July* 1, 1949).—Torque measurements on single crystals reveal marked anisotropy below 70°K. General behaviour is that of an anti-ferromagnetic, and susceptibility parallel to *c*-axis approaches zero at 0°K. N. F. A.

538.222

7152. Paramagnetic resonance spectra of five chromic sulfate alums. BLEANEY, B. Letter in *Phys. Rev.*, **75**, 1962–3 (*June* 15, 1949).—Measurements have been made on chromic alums of Rb, Cs and methylamine in addition to ammonium and potassium chromic alums. Observations were made at small intervals of wavelength between 3 cm and 10 cm at temps. down to 20°K. The differences between the spectra of the first group and of the other two alums are discussed. G. F. H.

538.222

7153. Microwave magnetic resonance absorption in oxygen. BERINGER, R. AND CASTLE, J. G., JR. Letter in *Phys. Rev.*, **75**, 1963 (*June* 15, 1949).—The absorption arising from magnetic dipole transitions between adjacent Zeeman components of the rotational levels of the O model has been detected by a technique which is essentially the microwave analogue of the radio-frequency nuclear magnetic resonance method. G. F. H.

538.222

7154. Magnetic properties of Mg–Ce alloys. MAHN, F. *Rev. Métall.*, **46**, 365–70 (*June*, 1949) *In French.*—Fe-free Mg–Ce alloys are shown to follow the Weiss law for paramagnetics. Anomalies in the curves relating susceptibility to composition correspond to definite compositions. Variations in Curie temp. with composition show similar results. N. F. A.

538.222

7155. A new phenomenon in paramagnetic relaxation. DE VRIJER, F. W. AND GORTER, C. J. Letter in *Physica*, **14**, 617 (*Jan.*, 1949) *In English.*—Experiments with Cr alums at the temperatures of liquid H and He, in parallel constant fields of a few hundred oersted indicate lattice relaxation at frequencies of the order of 10^4 and lower, and a new relaxation at frequencies of the order of 10^7. It seems that there is relaxation in the spin system under the influence of the internal electric fields and the constant magnetic field. It is suggested that this relaxation consists in the establishment of thermodynamic equilibrium between two groups of energy differences. G. F. H.

538.222

7156. Paramagnetic resonance in the copper Tutton salts. BLEANEY, B., PENROSE, R. P. AND PLUMPTON, B. I. *Proc. Roy. Soc. A*, **198** (*No.* 1054) 406–28 (*Aug.*, 1949).—I. Seven of the double sulphates and selenates ("Tutton salts") of Cu have been examined by the method of paramagnetic resonance. The deviation of the effective gyromagnetic ratio from the free-spin value of 2 is shown to be generally consistent with the theory of Polder [Abstr. 3257 (1946)], who assumes a crystalline electric field of tetragonal symmetry to act on each ion. In some salts an appreciable departure from tetragonal symmetry is observed. II. The variation of the width of the absorption lines with the direction of the applied magnetic field is studied and compared with that calculated from magnetic dipole interaction. The line shapes show that exchange interaction is present in varying degree, though much less powerful than in $CuSO_4$. The "mean square moment" of the lines can be explained by the magnetic dipole interaction,

together with a contribution from a hyperfine structure which is not resolved except in a highly diluted salt. A.

538.222 : 548.0

Paramagnetic resonance absorption in crystals colored by irradiation. *See Abstr.* 7384

538.224

7157. Magnetic susceptibilities of some inorganic anions. PRASAD, M. AND DESAI, D. M. *Proc. Nat. Inst. Sci. India*, **15**, 145–59 (*May*, 1949).—Magnetic susceptibilities of a number of pure salts containing SO_4'', S_2O_8'', SO_3'', NO_3, ClO_3', IO_3', CO_3'' and PO_4' ions have been determined by the use of a modified form of Guoy's balance. The values for the susceptibilities of the anions have been deduced from the data by using all the known values for the cations reported in literature. These values have been compared with the values reported by various workers and in some cases the causes of disagreement of the reported values with the authors' values have been discussed. The average values have also been compared and found to be in good agreement with those obtained by using the theoretical values of the cations calculated by Pauling's, Slater's, Angus's and Hartree-Stoner's methods. Values have also been calculated for these anions by using Slater's values for the central ion and O atoms surrounding them and from the differences between the calculated and the observed values, bond depression per O atom has been calculated on the assumption that each O produces the same depression in combining with the central atom. Ikenmeyer's relation has been discussed in the case of some of the Na and K salts studied in this investigation. The patterns obtained on plotting χ_m for corresponding salts of Na and K against the total number of electrons in the compounds are strikingly similar in nature showing a chemical resemblance of these salts. A.

538.24

7158. A new elementary theory of magnetization curves. PROCOPIU, S. *C.R. Acad. Sci., Paris*, **228**, 475–6 (*Feb.* 7, 1949) *In French.*—Assumes a Maxwellian distribution of critical fields for the domains and derives a series representing the I–H curve. An alternative to Rayleigh's law for low fields is proposed. N. F. A.

538.245

7159. Magnetic viscosity in large masses of metal. EPELBOIM, I. AND MARAIS, A. *C.R. Acad. Sci., Paris*, **228**, 1110–12 (*March* 28, 1949) *In French.*—By measuring the permeability of ferromagnetic materials before and after electrolytic removal of the surface layers, the contribution to the magnetic viscosity of the magnetic texture and of the condition of the surface layers may be assessed. Some results are quoted for Mumetal and Permalloy. H. J. H. S.

ELECTROMAGNETISM . ELECTRODYNAMICS 538.3/.5

538.3

7160. Polarization of the vacuum. RAYSKI, J. Letter in *Phys. Rev.*, **75**, 1961–2 (*June* 15, 1949).—To restore gauge invariance in the Schwinger electrodynamic theory a regularization procedure must be adopted, where the products of the $\bar{\Delta}$ and $\Delta^{(1)}$ functions in the expressions for vacuum polarization are replaced by $\Sigma C_i \bar{\Delta}(m_i)\Delta^{(1)}(m_i)$, where $m_0 =$ electron mass, $m_i (i = 1, 2 \ldots)$ are auxiliary masses tending to ∞, and $\Sigma C_i = 0$, $\Sigma C_i m_i^2 = 0$. G. J. K.

538.3 : 530.14

A note on Podolsky electrodynamics. *See Abstr.* 6740

538.3 : 530.145

Quantum electrodynamics. *See Abstr.* 6751

538.521 : 621.317.78 : 621.317.44

7161. Apparatus for measuring power loss in small ferromagnetic samples subject to an alternating field. STEWART, K. H. *Rep. Brit. Elect. Allied Industr. Res. Ass.* (*Ref. N/T42*) 12 *pp.* (1947).—The specimen is excited by a valve-oscillator covering 0·5–500 c/s and a centre-tapped search coil is connected to a B_{max} meter and a wattmeter alternatively. The coil output, $\propto dB/dt$, is amplified and rectified by an electronic commutator and measured by a null method. The wattmeter is electrodynamic with a long period and used with superimposed d.c. as a null indicator, the d.c. being measured by a substandard milliammeter. The method of measurement is detailed, with examples on B_{max} and loss measurements. Circuit diagrams of both instruments are given. E. H. W. B. (R)

538.566

7162. Theory of electromagnetic oscillation on a plate conductor. SAKURAI, T. *J. Phys. Soc. Japan*, **3**, 139–42 (*March–June*, 1948) *In English.*

538.566

7163. On the expressions of Huygens' principle for electromagnetic waves. CROZE, F. AND DURAND, E. *C.R. Acad. Sci., Paris*, **228**, 236–7 (*Jan.* 17, 1949) *In French.*—The correct expression of Huygens' principle may be derived from De Broglie's formulae in which only a surface density of electric and magnetic charge and current is assumed to exist on the elements of the wave surface. L. P.

538.566 : 535.13

7164. A reduction to unity of the expressions of Huygens' principle for electromagnetic waves. CROZE, F. AND DARMOIS, G. *C.R. Acad. Sci., Paris*, **228**, 824–6 (*March* 7, 1949) *In French.*—The formulations of Huygens' principle suggested by various authors are discussed, and it is shown that not all of them satisfy the three fundamental conditions established by Baker and Copson in "*The mathematical theory of Huyghens' principle.*" L. P.

538.566 : 621.396.11

7165. Electronics including fundamental emission phenomena. II. Wave propagation. PFISTER, W., BECKER, W., BECKMANN, B. AND SIEDENTOPF, H. *FIAT Rev. German Sci.* (1939–46) [*Off. Mil. Govt. Germany*] 127–71 (1948) *In German.*—A detailed survey of German research on propagation phenomena during the war years, supported by a considerable bibliography. The following are treated: theory of wave propagation along the surface of the earth with consideration of tropospheric influence; theory of wave-propagation in the ionosphere;

methods of measuring radiation from the ionosphere and troposphere; angle of incidence; polarization; transmission round the earth and general observation of atmospheric disturbances. A. L. (R)

538.566.2 : 621.392.2

7166. The application of conformal mapping to wave fields. MEINKE, H. *Z. angew. Phys.*, **1**, 245–52 (*Jan.*, 1949) *In German.*—Plane wave propagation between two generalized surfaces is reduced by conformal mapping to the motion of a plane wave between two parallel planes enclosing an inhomogeneous dielectric. Maxwell's equations are replaced by an infinite number of linear, second-order differential coefficients. The convergence condition allows one to approximate by using only two functions and this leads to a systematic method of approximation in which the electrostatic field is ordinarily the first stage. A. H. W. B.

538.566.2 : 621.396.11

7167. An extension of MacFarlane's method of deducing refractive index from radio observations. STRAITON, A. W. Letter in *J. Appl. Phys.*, **20**, 228 (*Feb.*, 1949).—It is shown that the method of MacFarlane [Abstr. 1956 (1948)] can be simplified if phase as well as signal strength is measured. Instead of several sets of height-gain measurements being required, only one set of height-gain and height-phase measurements is needed. J. M. H.

538.566.2 : 621.392.26

7168. On the stability and attenuation of guided waves of same cut-off frequency and of magnetic or electric type. MÜLLER, R. *Z. Naturforsch.*, **4a**, 218–24 (*June*, 1949) *In German.*—The problem is handled by perturbation methods. The important cases are the E_{1n} and H_{0n} waves in circular guide and the E_{1m} and H_{1m} waves in rectangular guide. In the circular guide the introduction of loss does not cause instability but unless the rectangle is a square, instability results in rectangular guide. A. H. W. B.

538.566.3 : 621.396.11

7169. Note on the maximum height of reflection of a radio wave in a curved ionosphere layer. KELSO, J. M. Letter in *J. Appl. Phys.*, **20**, 632–3 (*June*, 1949).—Note on the fact that in oblique incidence radio transmission the max. height of reflection is always below the level of max. ionization density. W. J. G. B.

538.566.3 : 621.396.11

7170. Magnetic triple splitting in the ionosphere. DIEMINGER, W. AND MÖLLER, H. G. *Naturwiss.*, **36** (*No.* 2) 56–7 (1949) *In German.*—A short note in which it is shown that the occasional observation of a third magneto-ionic component in vertical incidence radio sounding of the ionosphere can be explained in terms of a critical damping condition. W. J. G. B.

538.566 : 621.392.26 : 621.396.671

7171. Channel section waveguide radiator. CULLEN, A. L. *Phil. Mag.*, **40**, 417–28 (*April*, 1949).—The transmission properties are studied; formulae for the phase and attenuation coefficients are obtained. Experiments supporting the theory are described. L. S. G.

538.566 : 621.396.11

7172. Ground-wave propagation across a land/sea boundary. MILLINGTON, G. *Nature, Lond.*, **164**, 114 (*July* 16, 1949).—Field-strength measurements, using pulse signals on a wavelength of 96 m over a distance of 200 km across a land-sea boundary show the predicted recovery in field-strength on crossing the boundary and are in excellent agreement with values calculated by the method previously given by the author [Abstr. 3350 (1949)]. W. J. G. B.

538.566 : 621.396.11

7173. Ground-wave propagation across a land/sea boundary. ELSON, N. *Nature, Lond.*, **164**, 114–16 (*July* 16, 1949).—Relative field-strength measurements using tone modulated c.w. signals on a wavelength of 270 m over a distance of 380 km quantitatively confirm Millington's prediction [Abstr. 3350 (1949)] of a recovery in field-strength across a land-sea boundary at medium as well as at short wavelengths. W. J. G. B.

538.566 : 621.396.611.4

7174. Perturbation calculations on electromagnetic resonators with multiple eigen-value. LEDINEGG, E. *Öst. Ingen. Archiv.*, **3** (*No.* 3) 215–21 (1949) *In German.*—The perturbation theory of cavities in which degeneracy is eliminated by a small deformation of the boundary is developed: first for the case of n-fold degeneracy and then for two-fold degeneracy. A. H. W. B.

538.566.2 : 621.396.11

7175. Electric field of an oscillating dipole on the surface of a two layer earth. WOLF, A. *Geophysics*, **11**, 518–37 (*Oct.*, 1946).—The electric field of a l.f. oscillator placed on the surface of a 2 layer earth is determined in 2 special cases, namely, the case in which the conductivities of the 2 layers are nearly equal, and the case in which the lower layer is a perfect insulator; in the latter case, only terms of zero and first order in frequency are considered. It is shown that, when the upper layer is sufficiently thin or is very thick, the mutual inductance of 2 wire elements on the surface of a 2 layer earth has the same value as for a homogeneous earth. In the case of an insulated layer, it is shown that the max. departure of the value of mutual inductance of 2 collinear wire elements from the corresponding value on a homogeneous earth is 35%. A.

538.566.2 : 550.837.7 : 621.396.11

7176. Propagation of electromagnetic waves in earth. HAYCOCK, O. C., MADSEN, E. C. AND HURST, S. R. *Geophysics*, **14**, 162–71 (*April*, 1949).—The possibility of using radar to determine discontinuities within the earth is considered. Knowledge of the propagation characteristics of waves in the earth is required before such a development might be undertaken. The relevant literature is reviewed and measurements of velocity, attenuation and wavelength of electromagnetic waves in certain earthy materials are reported. A.

MAGNETIC EFFECTS 538.6

538.615 : 535.363.4–14

A new method of measurement of the Zeeman effect. *See Abstr.* 6905

538.632

7177. Hall effect in liquid rubidium. FAKIDOV, I. G. *Dokl. Akad. Nauk, SSSR*, **63** (*No.* 2) 123–5 (1948) *In Russian.*—Whilst earlier investigations make it appear probable that galvanomagnetic effects are absent in liquid metals, T. K. Kikoin and the author measured the Hall effect in liquid K–Na (50 atomic %) [*Z. f. Phys.*, **71** (*Nos* 5–6) 393 (1931)]. To establish this effect for pure metals in the liquid state, the author selected Rb as its m.p. (~ 28°C) is near room temp. Particular care was taken in the preparation of the liquid film serving as specimen, as it was not produced in vacuum and oxidation had to be avoided. The method of preparation is described and the 4-electrode arrangement shown. The measurements were made by a compensation method, at 35°C. The true Hall e.m.f., isolated on Ammerno's exclusion rule, varies linearly with H, and the Hall constant for liquid Rb $= (-4{\cdot}2 \pm 0{\cdot}5)10^{-4}$, whereas for solid Rb it is -5×10^{-4} c.g.s. units; in either case the number of conduction electrons n for Rb $\simeq$ the number of atoms per cm^3, agreeing with Sommerfeld's formula $R = 1/ne$. B. F. K.

538.65

7178. Influence of a magnetic field on the internal friction of reversible ferronickels. APERT, C. AND CABARAT, R. *C.R. Acad. Sci., Paris*, **228**, 490–2 (*Feb.* 7, 1949) *In French.*—Measurements of the decrement of longitudinal vibrations of ferronickel rods, containing 30 to 99% Ni, in magnetic fields of 0–400 oersted, show that the internal friction first increases rapidly wtih H, passes through a max., and decreases to a limiting value, which is practically reached at 300 oersted. The effect, so far unexplained, may be related to a similar one on the magnetostriction of iron. C. E. W.

538.662.1 : 621.363

7179. Thermomagnetic generator. BRILLOUIN, L. AND ISKENDERIAN, H. P. *Elect. Commun.*, **25**, 300–11 (*Sept.*, 1948).—Proposals have been made to use the properties of ferromagnetic substances near the Curie point for constructing thermomagnetic current generators. Large flux variations could be induced in a coil and a.c. generated by heating and cooling above and below its Curie point a ferromagnetic substance forming part of a magnetic circuit. The mechanism lies in a temp. dependence of the permeability of the substance and the associated thermomagnetic effects. The magnitude of the effect and of the efficiencies obtainable are calculated. P. O.

THEORY OF SOLID STATE 539.11

539.11

7180. A new theory of thermal agitation. CRUSSARD, C. *Physica*, **15**, 184–8 (*April*, 1949) *In French.*—A wave theory of thermal agitation in which account is taken of the phases of the waves to calculate the probability that a wave (or train of waves) arriving in a small region possesses enough energy to produce a particular reaction. At high temps. this probability is < that calculated by the Boltzmann formula if the required excitation energy is small, but greater for those reactions which require a large excitation energy. A. E. DE B.

539.11 : 669

7181. A method for calculating the energy of a Bloch wave in a metal. SHOEMAKER, D. P. *Physica*, **15**, 34–8 (*April*, 1949) *In English.*—The energy in a given band is calculated, for metals of high co-ordination number, on the basis of a model in which the polyhedral cell is replaced by a sphere of the same volume with the atomic nucleus at the centre. The expression for the energy is given in a form suitable for numerical calculation. A. E. DE B.

539.11 : 669

7182. The sizes of atoms in metallic crystals. HUME-ROTHERY, W. *Physica*, **15**, 29–33 (*April*, 1949) *In English.*—The factors influencing the sizes of atoms are considered briefly. In the case of solid solutions the structure of the solvent, the volume per valency electron of both elements concerned, the electrochemical factors and the effects of Brillouin zone overlap all affect the apparent atomic diameter. A. E. DE B.

539.11 : 669

7183. The resonating-valence-bond theory of metals. PAULING, L. *Physica*, **15**, 23–8 (*April*, 1949) *In English.*—The resonating valence bond theory of metals is discussed briefly and compared with the molecular-orbital theory. The concept of the metallic orbital is illustrated with reference to the possible electronic states of Li. A. E. DE B.

MOLECULAR STRUCTURE 539.13

539.13

7184. On the stability of positonium chloride. SIMONS, L. *Comment. Phys. Math., Helsingf.*, **14** (*No.* 9) 1–13 (1949) *In English.*—A refined approximation for the binding energy of positonium chloride considered as a molecule consisting of a Cl^- ion and a positon is given using a Hartree potential function for Cl. Solutions of the wave equation finite and non-zero for $r = 0$ satisfy a relation $f(r_0E_0) = 0$, those vanishing at $r=\infty$, $g(r_0E_0) = 0$ (r_0 positions of maxima). From intersection of these, the ground state eigen-function is found and eigen-value of energy as 0·28 Rh. Using HCl energy and wave function, a control by perturbation theory is carried out (up to 5th power of r) which confirms this energy value. Criterion for dynamic stability of positonium chloride is that $D > 0{\cdot}22$ Rh, D being work required for splitting system into Cl and positonium atom; hence dynamic stability is predicted. Account is now taken of disturbance of Cl^- ion field by positon—method to be published—which increases binding energy and hence stability. J. J.

539.13

7185. On the stability of systems containing a Cl^- ion and a light positive particle. SIMONS, L. *Comment. Phys. Math., Helsingf.*, **14** (*No.* 12) 1–15 (1949) *In English.*—By methods already described (preceding Abstr.) wave functions and energies of ground states

are calculated for systems of Cl^- ion and a positive light particle of mass $\mu = 2, 10, 100, 1\,830\ m_e$. For dynamic stability the dissociation energy $D > 0$; it is calculated as 0·79 eV for positonium chloride, and increases for other systems as μ increases. On basis of a similar Hartree–Fock field an approximate wave function for ground state of HCl is determined and energy checked by a perturbation calculation using a wave function of Gaussian type. Polarization of Hartree–Fock field by the positive particle is especially significant in HCl, giving a binding energy −15·6 eV (expt. −14·19 eV). In positonium chloride polarization decreases E (binding energy) from −3·79 eV to −6·49 eV. Thus dynamic stability of positonium chloride exists even if no polarization were allowed for; such stability increases with degree of polarization of the field. J. J.

539.132

7186. A further interpretation of interaction terms in the potential function of polyatomic molecules. DUCHESNE, J. AND MONFILS, A. Letter in *J. Chem. Phys.*, **17**, 586–7 (*June*, 1949).—By assuming that in symmetrical and asymmetrical linear triatomic molecules all the vibrations are truly harmonic, the length-length cross terms (f_{12}) of CO_2, CS_2, COS, COSe, HCN, ClCN, BrCN and ICN have been evaluated; it being assumed that CO and CN force constants remain the same. Calculations are made which support the view that the whole contribution of f_{12} arises from the interactions between the non-bonded atoms. W. R. A.

ATOMIC STRUCTURE . ISOTOPES 539.15

539.152

7187. On the formulas for the relative multiplet strengths in *LS* coupling. AMEMIYA, A. *J. Phys. Soc. Japan*, **2**, 62–5 (*July–Aug.*, 1948) *In English.*

539.152.1

7188. Erratum: Phenomenological theory of exchange currents in nuclei. SACHS, R. G. *Phys. Rev.*, **75**, 1605 (*May* 15, 1949).—See Abstr. 3862 (1948).

539.152.1

7189. The shell structure of atomic nuclei. BAGGE, E. Letter in *Naturwiss.*, **35** (*No.* 12) 375 (1948) *In German.*—The numbers 50, 82 and 126 of nucleons which form particularly stable nuclei are expressed as a simple sequence, and a corresponding model is described. B. R.

539.152.1

7190. On the interpretation of particular nucleon numbers in the structure of the nucleus. HAXEL, O., JENSEN, J. H. D. AND SUESS, H. E. Letter in *Naturwiss.*, **35** (*No.* 12) 376 (1948) *In German.*—Two nuclear term schemes are proposed on the basis of strong spin-orbit coupling to account for the appearance of magic numbers in nuclear structure. B. R.

539.152.1

7191. On the systematics of heavy nuclei. BRONIEWSKI, A. *C.R. Acad. Sci., Paris*, **228**, 174–6 (*Jan.* 10, 1949) *In French.*—Draws attention to certain regularities in α-particle stability in terms of the relation of nuclei to the condensed nucleus Pb^{208}. B. R.

539.152.1

7192. Neutron and proton binding energies in the region of lead. WAY, K. Letter in *Phys. Rev.*, **75**, 1448–9 (*May* 1, 1949).—The binding energies are estimated from available data on α and β decay energies. The results indicate that binding energy falls sharply for the 127th neutron and the 83rd proton in the nucleus. This supports the hypothesis that closed shells are formed by 126 neutrons and 82 protons. L. R. S.

539.152.1

7193. On the "magic numbers" in nuclear structure. HAXEL, O., JENSEN, J. H. D. AND SUESS, H. E. Letter in *Phys. Rev.*, **75**, 1766 (*June* 1, 1949).—A simple explanation of the "magic numbers" 14, 28, 50, 82, 126 follows at once from the oscillator model of the nucleus, if the spin-orbit coupling in the Yukawa field theory leads to a strong splitting of a term with angular momentum l into 2 distinct terms $j = l + \frac{1}{2}$. A.

539.152.1

7194. On the excited states of Li^7. HANNA, S. S. AND INGLIS, D. R. Letter in *Phys. Rev.*, **75**, 1767 (*June* 1, 1949).—It is suggested that the first excited state has $I = 5/2$. [See also Abstr. 7278 (1949)]. B. R.

539.152.1 : 539.163.2

7195. Nuclear isomerism. SEGRÈ, E. AND HELMHOLZ, A. C. *Rev. Mod. Phys.*, **21**, 271–304 (*April*, 1949).—Review article of experimental and theoretical work, containing tables of isomers and neutron cross-sections, and bibliography. The theory is discussed in terms of Weizsäcker's hypothesis. B. R.

539.152.2

7196. Observation of nuclear magnetic resonance with a super-regenerative receiver. GRIVET, P. AND SOUTIF, M. Note in *C.R. Acad. Sci., Paris*, **228**, 1852–4 (*June* 13, 1949) *In French.*—Experimental details. D. H. W.

539.152.2

7197. The autodyne method in nuclear magnetic resonance. GRIVET, P., SOUTIF, M. AND GABILLARD, R. Note in *C.R. Acad. Sci., Paris*, **229**, 27–9 (*July* 4, 1949) *In French.*—Experimental details whereby the change of resistance and induction of a coil at a nuclear resonance frequency are observed. D. H. W.

539.152.2

7198. The magnetic moment of Tl^{203}. PROCTOR, W. G. Letter in *Phys. Rev.*, **75**, 522–3 (*Feb.* 1, 1949).—Nuclear magnetic resonance experiments on thallium acetate give magnetic moments $Tl^{203} = 0{\cdot}5714 \pm 0{\cdot}0001$ and $Tl^{205} = 0{\cdot}5770 \pm 0{\cdot}0001$ times the proton moment. The intensities indicate spins of $\frac{1}{2}$ and the moments are positive. D. H. W.

539.152.2

7199. Microwave magnetic resonance absorption in a nickel salt near 1·25 cm. HOLDEN, A. N., KITTEL, C. AND YAGER, W. A. Letter in *Phys. Rev.*, **75**, 1443 (*May* 1, 1949).

539.153

7200. On the wave-mechanical derivation of the statistical model of the atom. FÉNYES, I. *Z. Phys.*, **125** (*Nos* 4–6) 336–46 (1948) *In German.*—The

Wentzel–Brillouin–Kramers approx. method is applied to the equations of the self-consistent field model of the atom. Zero-order approx. leads to the Thomas–Fermi model or associated models, according to the interaction terms included. First-order approx. gives the kinetic energy correction due to von Weizsäcker. G. J. K.

539.153 : 539.152.1

7201. The hyperfine structure of the ground term of hydrogen. Breit, G. and Meyerott, R. E. Letter in *Phys. Rev.*, **75,** 1447 (*May* 1, 1949).—Approximations made in an earlier paper [Abstr. 701 (1948)] are more clearly stated, to remove any misunderstanding as to the accuracy of the results. G. J. K.

539.153 : 535.33

7202. Atomic energy levels (as derived from the analysis of optical spectra). I. ^{1}H–^{23}V. Moore, C. E. *Circ. U.S. Bur. Stand.* (*No.* 467) *pp.* xliii + 309 (1949).—This volume comprises the first three sections [the first section was earlier published separately; see Abstr. 665 (1949)]. It contains a critically evaluated compilation of all known data on the energy levels of elements of atomic number 1 to 23 inclusive. Hyperfine structure levels due to atomic nuclei are not included. Tables are given of Landé g-values, predicted terms of iso-electronic sequences, and ionization potentials. For each spectrum a selected bibliography covering the analysis is given.

539.153.4

7203. Interaction of configurations in the carbon atom. Yutsis, A. P. *J. Exp. Theor. Phys., USSR,* **19,** 565–76 (*July,* 1949) *In Russian.*—One-electron wave-functions based on self-consistent field without exchange are used to determine energy levels of the free C atom. Configurations $1s^22s^22p^2$, $1s^22p^4$, $1s^22s^22p3p$, $1s^22s2p^23s$, are discussed and their interactions determined from the non-diagonal elements in the energy matrix. The energy of the ground level is lowered through interaction of $1s^22s^22p^2$ with $1s^22p^4$, other configurations being much less effective. Configurational interaction leads also to an improved term sequence. Wave-functions are given, together with values of elements of the energy matrix. Term differences are still not satisfactory; it is suggested that incomplete separation of the variables in the wave-function may improve these. J. J.

539.153.4

7204. Analytical expression of self-consistent functions and doublet intervals for F I, Ne II, Mg IV and Al V. Wataki, W. *Progr. Theor. Phys.*, **4,** 42–6 (*Jan.–March,* 1949) *In English.*—See Abstr. 6369 (1949).

539.154

7205. An accurate nuclear magnetic resonance method for measuring spin-lattice relaxation times. Hahn, E. L. Letter in *Phys. Rev.*, **76,** 145–6 (*July* 1, 1949).—The bridge method for obtaining nuclear magnetic resonance has been applied in conjunction with an electronic technique. Results given for the case of protons in distilled water indicate a spin-lattice relaxation time of $2{\cdot}33 \pm 0{\cdot}07$ sec. G. F. H.

539.154

7206. A simplified high frequency bridge for observation of nuclear magnetic resonance. Grivet, P., Soutif, M. and Buyle, M. *C.R. Acad. Sci., Paris,* **229,** 113–15 (*July* 11, 1949) *In French.*—A low impedance bridge is described which makes use of a series-resonant circuit to replace the parallel resonance employed in the Purcell and Pound bridge [see Abstr. 2529 (1948)]. G. F. H.

539.154

7207. Neutron-hydrogen mass difference from the D-D reactions. Tollestrup, A. V., Jenkins, F. A., Fowler, W. A. and Lauritsen, C. C. Letter in *Phys. Rev.*, **75,** 1947–8 (*June* 15, 1949).—The reactions $D^2 + D^2 \rightarrow H^3 + H^1 + Q_1$, $D^2 + D^2 \rightarrow He^3 + n^1 + Q_2$ were investigated by irradiating continuously condensed D_2O targets with deuterons from an electrostatic generator and analyser (mono-energetic to $< 0{\cdot}1\%$). He^3 and H^3 were detected by a scintillation counter and their energies measured in a double-focusing magnetic spectrometer (for angles of emission $134{\cdot}5° - 141{\cdot}1°$). Calibration of the analyser and spectrometer, corrections for target thickness and evaluation of probable errors are described. Weighted average results are $Q_1 = 4{\cdot}036 \pm 0{\cdot}022$ MeV, $Q_2 = 3{\cdot}265 \pm 0{\cdot}018$ MeV, giving $n^1 - H^1 = 789 \pm 6$ keV and, from mass spectroscopic data for $2H^1 - H^2$, the binding energy of the deuteron $= 2{\cdot}221 \pm 0{\cdot}006$ MeV. T. G. P.

539.154

7208. The magnetic moment of Be^9. Dickinson, W. C. and Wimett, T. F. Letter in *Phys. Rev.*, **75,** 1769 (*June* 1, 1949).—The frequency ratio of the H^1 and Be^9 resonances in the magnetic resonance absorption method was measured, from which $\mu(Be^9) = (-)(1{\cdot}17747 \pm 0{\cdot}00027)\mu_N$. The error is due solely to the error in $\mu(H^1)$. B. R.

539.154

7209. The nuclear moments of P^{31}. Crawford, M. F. and Levinson, J. *Canad. J. Res. A,* **27,** 156–63 (*July,* 1949).—Hyperfine structures have been observed in the $3s4s\ ^3S_1 - 3s4p\ ^3P^0_{0,1,2}$ transitions of P IV with a 21 ft concave grating and in the $4s\ ^2S_{\frac{1}{2}} - 4p\ ^2P^0_{\frac{1}{2}}$ transition of P III with a transmission echelon. The $\frac{1}{2}$-widths of the lines, excited in an electrodeless discharge, were reduced by mixing Ne with the P vapour and by using a condenser of small capacity. Their intensities were increased by discharging the condenser through the exciting coil 9 times per $\frac{1}{2}$-cycle by means of a rotating spark gap. The structures of the P IV lines confirm $I = \frac{1}{2}$ and show that μ, the nuclear magnetic moment, is positive. $\mu = 1{\cdot}15 \pm 0{\cdot}05$ n.m. and $\mu = 1{\cdot}11 \pm 0{\cdot}1$ n.m. are obtained from the P IV and P III structures, respectively. A.

539.154.2

7210. The actinide series and the periodic table. Szabó, Z. Letter in *Phys. Rev.*, **76,** 147–8 (*July* 1, 1949).—Presents chemical evidence for putting Th, U, Pa and the transuranic elements in a group (III) starting with Ac. A. O. S.

539.155.2

7211. The cosmic abundance of the chemical elements. Suess, H. E. *Experientia,* **5,** 266–70 (*July* 15, 1949) *In German.*—By multiplying by certain factors of correction Goldschmidt's or Unsöld's values for the relative abundance of the elements, a general and coherent picture of the abundance of

nuclei can be derived showing that simple rules hold for the abundance of the different types of nuclei. From the fact that these factors of correction are small and within the limits of error for the majority of the elements, it is to be concluded that the values given by these authors are not far from representing the relative amounts in which the elements originally have been formed. For a small number of elements a comparatively large correction of Goldschmidt's values is needed, but these elements nearly all belong to the same geochemical group, viz. that of the "calcophile" elements. Revised abundance values are tabled, including those for the rare gases. Two plots illustrate the general picture of nuclear abundance. Reference is made to the significance of this picture as a lead towards better theoretical understanding of the structure of the nuclei, and of the formation of the elements. A.

539.155.2

7212. Isotopic weight doublet in the $B_2^{11}D_6$ and O_2 mass spectrum. NORTON, F. J. Letter in *Phys. Rev.*, **75,** 1957 (*June* 15, 1949).—$B_2^{11}D_3^+$ (isotopic weight 32·0994) and O_2^{16+} (32·0000) were resolved in a mass spectrometer. T. G. P.

539.155.2

7213. Preparation and extraction of S^{35}. WILK, M. B. *Canad. J. Res. B*, **27,** 475–88 (*June*, 1949).—Procedures are described for the preparation and extraction of carrier-free S^{35}, based on the $Cl^{35}(n,p)S^{35}$ reaction. KCl, NaCl and ferric chloride have been used as target materials. The S^{35} is found to appear in a chemical form which exchanges rapidly with sulphate ion. Separation of S^{35} from irradiated KCl or NaCl is effected by taking advantage of the insolubility of these salts in aqueous HCl solutions. Approx. 99·8% of the salt can be removed while leaving 95% of the S^{35} in solution. Separation from irradiated ferric chloride is effected by solvent extraction of the ferric chloride from aqueous 6 to 8 *M* HCl solutions. $< 0{\cdot}1\%$ of the total solids is left unextracted. The yield of S^{35} approaches 100%. A.

539.155.2

7214. Mass spectrum of hydrogen deuteride (HD). FRIEDEL, R. A. AND SHARKEY, A. G., JR. Letter in *J. Chem. Phys.*, **17,** 584–5 (*June*, 1949).—Relative rates of diffusion into a mass spectrometer of H_2 (at mass 2) and HD (at mass 3) were found to be 12·72, 10·46% per minute. A straight-line plot between these two points enabled mixtures of H_2 and HD to be analysed by measuring diffusion rates and thus to eliminate H_2 impurity in analysing D^+ from HD. Relative abundances of all ions from HD, H_2 and D_2 are tabulated. The equilibrium constant for $H_2 + D_2 \rightleftharpoons 2HD$ at 500°C was calculated, using these data: $K_{500°C} = 3{\cdot}87 \pm 0{\cdot}02$. T. G. P.

RADIOACTIVITY . α-, β- AND γ-RAYS 539.16

539.16 : 551.59

7215. On the radioactivity of the atmosphere. GARRIGUE, H. *C.R. Acad. Sci., Paris*, **228,** 1583–4 (*May* 16, 1949) *In French.*—Traces ($\simeq 10^{-21}$–10^{-18} curie-equiv. of Rn/cm³) of a radioactive body, *A*, of ½-life ~25 hr were obtained at high altitude (6–8 000 m) with an ionization chamber; a further radio-active body, *A'*, with a ½-life of a few hours, may also have been detected. They may be due to atomic bomb explosions (Bikini), or perhaps to meteoric material or cosmic radiation. A. O. S.

539.16.08

7216. On the activity of radioactive inclusions in eruptive rocks. COPPENS, R. *C.R. Acad. Sci., Paris*, **228,** 176–8 (*Jan.* 10, 1949) *In French.*—Various rocks were examined by placing pulverized samples on Ilford plates. α-particle tracks were observed to originate non-uniformly, from localized sources, in which the Th and U concentrations were estimated to be 25% and 10% respectively. B. R.

539.16.08

7217. Measurement of radioactive isotopes. CURTISS, L. F. *Circ. U.S. Bur. Stand.* (*No.* 473) 1–12 (1948).—A manual intended to accompany radioactive standards and calibrated samples of radioisotopes. It contains a discussion of the principles of measurement of radioisotopes in absolute terms with explanation of units and illustrative examples of precautions that must be taken in measurements to determine disintegration rates. A simple chart for computation of radioactive decay is included. A.

539.16.08

7218. A modified Lauritsen electroscope for the measurement of C^{14} activities. HUNTER, R. F. AND MANN, W. B. *Nat. Res. Coun. Can. Publ.* (*No.* 1905) 3 *pp.* (1948).—The C^{14} is assayed as sodium carbonate evaporated on to an Al disc. A brass slide on the modified electroscope body allows the disc to be brought opposite an opening in the ionization chamber, the slide being designed so that the chamber is never open to the air. Comparison with a G.M. counter showed comparable sensitivity, and gave evidence of self-absorption in the sample (0·036 mgm/cm² of solid matter). L. E. M.

539.163

7219. On the decay of K^{40}. FIREMAN, E. L. Letter in *Phys. Rev.*, **75,** 1447 (*May* 1, 1949).—The ratio of positron emission to orbital electron capture in the decay of K^{40} to A^{40} is estimated as a function of the A^{40}–K^{40} mass difference on a theoretical basis, assuming a 3rd forbidden transition with axial vector or tensor interaction. Experimental results are quoted giving $\lambda\beta^+/\lambda c < 0{\cdot}005$ from which it is deduced that the A^{40}–K^{40} mass difference is $< 1{\cdot}6$ MeV. The ratio of the matrix elements for the K^{40}–A^{40} and K^{40}–Ca^{40} transitions is estimated from reported values of $E\beta^- = 1{\cdot}4$ and $\lambda\beta^-/\lambda c = \frac{1}{2}$ or 10. L. R. S.

539.163.1

7220. The half life of C^{14}. HAWKINGS, R. C., HUNTER, R. F., MANN, W. B. AND STEVENS, W. H. *Canad. J. Res. B*, **27,** 545–54 (*June*, 1949).—Compensated gas counters of known efficiency, filled with CS_2 and CO_2 containing a mass-spectrometrically determined proportion of $C^{14}O_2$, have been used to determine the ½-life of C^{14}. It is found to be 6 360 ± 200 yr. A.

539.163.1

7221. The decay constant of radio-sodium, ^{24}Na. WILSON, R. AND BISHOP, G. R. Letter in *Proc. Phys. Soc., Lond. A*, **62**, 457–9 (*July*, 1949).—Ionization currents produced by Na^{24} γ-rays in a 50 cm diameter ion chamber were measured by a backed-off 954 electrometer valve circuit, and compared with those caused by a radio-thorium standard. Linear logarithmic decay plots gave the following results: $\frac{1}{2}$-life = $14{\cdot}90 \pm 0{\cdot}02$ hr, decay constant = $0{\cdot}04652 \pm 0{\cdot}000062$ hr^{-1}. T. G. P.

539.163.1

7222. Branching ratio in Be^7 decay. TURNER, C. M. Letter in *Phys. Rev.*, **76**, 148–9 (*July* 1, 1949).—The branching through the 475 keV level of Li^7, in the decay of Be^7 by orbital electron capture, is being measured by comparing the intensity of the γ radiation from a Be^7 source, with that of the annihilation radiation from a source of C^{11} of known strength relative to the Be^7. Both sources are prepared by (p, n) reactions in a Van de Graff generator and their relative strengths obtained from the neutron induced activities of a Mn bath surrounding the source. The samples are examined with a Geiger counter under conditions of identical geometry, with sufficient absorber between samples and counter to convert all the C^{11} positrons into annihilation quanta. The latter are assumed to be counted with the same efficiency as the 475 keV quanta. Preliminary results indicate that between 0·10 and 0·13 of the Be^7 disintegrations go through the excited state of Li^7. L. R. S.

539.163.1

7223. Measurement of a $2{\cdot}3\times10^{-8}$ second metastable state in Hg^{198}. MACINTYRE, W. J. Letter in *Phys. Rev.*, **76**, 312–13 (*July* 15, 1949).—Using polystyrene as the phosphor, a β–γ delayed coincidence curve between two scintillation counters, and between a scintillation counter and a proportional counter, showed the above $\frac{1}{2}$-life, in disagreement with earlier work [Abstr. 2916 (1948)]. B. R.

539.163.1

7224. Decay scheme of Ni^{65}. SIEGBAHN, K. AND GHOSH, A. Letter in *Phys. Rev.*, **76**, 307–8 (*July* 15, 1949).—Using spectrometer and coincidence techniques, 2·6 hr Ni^{65} was found to show 3 partial β-spectra, end points 0·60, 1·01 and 2·10 MeV, abundances 29, 14 and 57% resp., and to emit γ-rays of energies 0·37, 1·12 and 1·49 MeV. A level scheme is proposed and the theoretical implications concerning the spins and parities of the levels are discussed. B. R.

539.163.1

7225. On the measurement of short-lived isomers of nuclei. MCGOWAN, F. K., DE BENEDETTI, S. AND FRANCIS, J. E., JR. Letter in *Phys. Rev.*, **75**, 1761 (*June* 1, 1949).—The method of delayed coincidences between two anthracene scintillation counters has been extended to measure time intervals of 10^{-6}–10^{-7} sec. The $\frac{1}{2}$-lives of the isomeric states of Re^{187} and Ge^{72} are given as $(5{\cdot}5 \pm 0{\cdot}5)\times10^{-7}$ and $(2{\cdot}9 \pm 0{\cdot}06)\times10^{-7}$ sec resp. The reported $\frac{1}{2}$-life, 2–3×10^{-7} sec, for the isomeric state of Hg^{198} following the β^--decay of Au^{198} was not confirmed [Madansky and Wiedenbeck, *ibid.*, **72**, 185 (1947)]. A. O. S.

539.163.2

7226. Classical radioactivity, 1940–1949. FEATHER, N. *Nucleonics*, **5** (*No.* 1) 22–41 (*July*, 1949).—The paper deals with studies of the radiations from the heavy naturally radioactive elements ($Z = 81$ to 92). After a brief survey of the available methods of observation, the significant information for each isotope is listed; data are selected chiefly for the light that they may throw on transformation schemes. (190 refs.). A. P. F.

539.163.2

7227. Dual decay of In^{114}. BOEHM, F. AND PREISWERK, P. *Helv. Phys. Acta*, **22** (*No.* 3) 331–8 (1949) *In German.*—The decay of In^{114} was shown to be complex, $(3 \pm 1)\%$ of disintegrations leading by K-capture to an excited state of Cd^{114} which emits 2 γ-rays of 715 and 548 ($\pm$ 10) keV in cascade. There are also indications of positron emission with an upper energy limit of 650 $\pm$ 100 keV and intensity $\beta^+/\beta^- = 10^{-4}$. A. O. S.

539.163.2

7228. The decay of Co^{55}. DEUTSCH, M. AND HEDGRAN, A. Letter in *Phys. Rev.*, **75**, 1443–4 (*May* 1, 1949).—18·2 hr Co^{55} prepared by deuteron bombardment of Fe, was studied in a large double-focusing spectrometer. The positron spectrum consists of two components, with end-points 1·50 MeV and 1·01 MeV and almost equal intensity. γ-rays of energy 0·477 MeV, 0·935 MeV and 1·41 MeV, and relative intensities 0·3, 1·4 and 0·3 per positron, respectively, were measured with the help of a Pb radiator. Internal conversion electrons were observed, for all these γ-rays and for a lower energy radiation of 0·095 MeV. Coincidences were studied between γ-rays and positrons focused in the spectrometer, and a decay scheme is suggested. L. R. S.

539.163.2

7229. Radiations from Lu^{177}. DOUGLAS, D. G. Letter in *Phys. Rev.*, **75**, 1960–1 (*June* 15, 1949).—Lu_2O_3 irradiated by pile neutrons was studied in a thin lens spectrometer. Secondary electrons from Pb, Au and Sn radiators revealed γ-rays of energies $112{\cdot}2 \pm 0{\cdot}6$, $206{\cdot}3 \pm 1{\cdot}0$ and $317{\cdot}3 \pm 1{\cdot}5$ keV, while a Kurie plot of the β spectrum gave end-points at 169 $\pm$ 10, 366 $\pm$ 25 and 495 $\pm$ 5 keV. A decay scheme which is consistent with these results is given. K, L and M conversion lines due to the 112·2 keV transition and a K conversion line due to the 206·3 keV radiation were observed with the β spectrum. The $\frac{1}{2}$-life was found to be $6{\cdot}98 \pm 0{\cdot}10$ d. L. R. S.

539.163.2

7230. The gamma rays of radium (B + C). MANN, K. C. AND OZEROFF, M. J. *Canad. J. Res. A*, **27**, 164–8 (*July*, 1949).—An experiment has been performed to verify the γ-ray energy spectrum of Radium (B + C) as reported by Latyshev and associates [Abstr. 2971 (1947)]. The spectrum was obtained by measuring the energies of photoelectrons ejected from a thin Pb radiator by means of a thin-lens magnetic β-ray spectrometer. The spectrum obtained failed to reveal the presence of transitions other than those reported by Ellis [*Proc. Roy. Soc. A*, **138**, 318 (1932); **143**, 350 (1934)]. Comparative results are presented. A.

539.163.2

7231. On the use of the methods of critical absorption and reflexion in a study of the non-existence of *K*-capture in the nuclide ^{198}Au. RENARD, G.-A. *C.R. Acad. Sci., Paris*, **228**, 387–9 (*Jan.* 31, 1949) *In French.*—The probability of disintegration of Au^{198} by *K*-capture is at most 4×10^{-3}. A. O. S.

539.163.2

7232. On the beta-particle spectrum from the decay of radium E. WALTNER, A. AND ROGERS, F. T., JR. Letter in *Phys. Rev.*, **75**, 1445–6 (*May* 1, 1949).—Observations of β-particle tracks from $Bi^{210}(CH_3)_3$ were made in a cloud chamber. 131 tracks were photographed non-stereoscopically and measured by Petrova's method [*Zeits. f. Physik*, **55**, 628 (1929)]. Energies were derived from the best available relations for the range and stopping power for low energy particles. Results indicate that the max. intensity of the energy distribution occurs at about 30 keV and that the intensity drops away rapidly for lower energies. This appears to contradict the accepted theory of β-decay. L. R. S.

539.163.2

7233. Beta-decay spectrum of Ag^{110}. EMMERICH, W. S. AND KURBATOV, J. D. Letter in *Phys. Rev.*, **75**, 1446–7 (*May* 1, 1949).—The decay of Ag^{110} was studied in a cloud chamber, with a source of high specific activity mounted on zapon film. Photographs of tracks in air, with 372·5 gauss magnetic field, showed the presence of conversion electrons and a continuous negative electron spectrum. The Kurie plot was straight in the range 150 keV–550 keV with the end-point 0·59 MeV. Single positrons and pairs were observed. The number of β^+ particles did not exceed 0·2% of the β^- particles. Photographs of tracks in He, with a field of 149 gauss, showed the existence of a soft β-spectrum with end-point 90 ± 10 keV. L. R. S.

539.163.2

7234. The electron spectrum of iodine^{131}. CORK, J. M., KELLER, H. B., SAZYNSKI, J., RUTLEDGE, W. C. AND STODDARD, A. E. Letter in *Phys. Rev.*, **75**, 1621–2 (*May* 15, 1949).—The conversion electron spectrum of I^{131} has been measured by magnetic spectrometer with photographic recording and 5 γ-ray energies 80·1, 163·6, 177·0, 284·1 and 364·2 keV determined. A level scheme is suggested for Xe^{131}. A γ-ray of higher energy measured roughly by Pb absorption has an energy of 625 keV according to the proposed scheme. L. R. S.

539.163.2

7235. The interpretation of the K^{42} radioactivity. SHULL, F. B. AND FEENBERG, E. Letter in *Phys. Rev.*, **75**, 1768–9 (*June* 1, 1949).—It is suggested that the product $(W_0^2-1)ft$, should be more nearly constant than ft [Abstr. 929 (1944)] in the case of 1st forbidden transitions in which $\Delta I = \pm 2$. A number of β-active isotopes, which have been found to have a spectrum shape predicted for this type of transition, have a fairly constant value of $(W_0^2-1)ft \sim 10^{10}$. The β-activity of K^{42} has a value of $0{\cdot}7\times10^{10}$ for this product and analysis of results given by Siegbahn [Abstr. 2224 (1947)] indicate that the β-spectrum of transitions to the ground state has the form expected for the 1st forbidden decay with $\Delta I = \pm 2$. The transition to the excited state of Ca^{42} (1·5 MeV) is interpreted to be 1st forbidden with $\Delta I = 0$. L. R. S.

539.163.2

7236. Shape of the beta-spectra of Sr^{90} and Y^{90}. JENSEN, E. N. AND LASLETT, L. J. Letter in *Phys. Rev.*, **75**, 1949–50 (*June* 15, 1949).—A composite Sr^{90}–Y^{90} source and separated Sr^{90} were examined in a magnetic lens spectrometer. Kurie plots revealed a departure from the allowed shape of β-spectrum. The observed spectra have the forms to be expected of first forbidden transitions with $\Delta J = \pm 2$ and end-points $2{\cdot}05\ mc^2$ and $5{\cdot}37mc^2$ for Sr^{90} and Y^{90} respectively. These results are in agreement with those obtained by Braden *et al.* [see following Abstr.] and confirm predictions of Feenberg and Hammack. L. R. S.

539.163.2

7237. The forbidden beta-decay of Sr^{90} and Y^{90}. BRADEN, C. H., SLACK, L. AND SHULL, F. B. Letter in *Phys. Rev.*, **75**, 1964–5 (*June* 15, 1949).—Sr^{90} and Y^{90} sources were examined in a double focusing spectrometer. The end-point of the Sr^{90} beta spectrum was found to be $2{\cdot}04\ mc^2$ and that of Y^{90} $5{\cdot}40\ mc^2$. The characteristic shape for first forbidden transitions with $\Delta J = \pm 2$ was observed for both beta spectra [see previous Abstr.]. These results are explained by assigning even parity and spin zero to the ground states of Sr^{90} and Zr^{90} and odd parity with spin 2 to Y^{90} ground state. L. R. S.

539.163.2

7238. The positron decay of F^{18}. BLASER, J. P., BOEHM, F. AND MARMIER, P. Letter in *Phys. Rev.*, **75**, 1953 (*June* 15, 1949).—112 minute F^{18} was produced by the reaction $O^{18}(p,n)F^{18}$ from the bombardment of mica foil ($KAl_3Si_3H_2O_{12}$) with 5·5 MeV protons in a cyclotron. After the short period Al, Si and O activities had decayed the residual activity was due almost entirely to the β^+ decay of F^{18}. Examination in a magnetic lens spectrometer revealed a simple positron spectrum of the allowed form with an end-point of 635 ± 15 keV. L. R. S.

539.163.2

7239. The forbidden beta-decay of Sr^{89}. SLACK, L., BRADEN, C. H. AND SHULL, F. B. Letter in *Phys. Rev.*, **75**, 1965–6 (*June* 15, 1949).—The β-spectrum of 55 d Sr^{89} was observed in the double focusing spectrometer. An end-point of $3{\cdot}93\ mc^2$ was obtained and the shape of the spectrum was found to correspond to a transition with $\Delta J = \pm 2$ and parity change. No γ-radiation was detected. L. R. S.

539.163.2 : 539.164

7240. The alpha particle spectrum emitted by RdTh + ThX. ROSENBLUM, S., VALADARES, M. AND PEREY, M. *C.R. Acad. Sci., Paris*, **228**, 385–7 (*Jan.* 31, 1949) *In French.*—Two new α-groups (α_1, α_2(?)) belonging to ThX have been observed using a large permanent magnet spectrograph; the energy diff. α_0–α_1 ThX is 245 keV [cf. 250 keV γ-ray of von Bayer *et al.*, *Phys. Zeits.*, **16**, 6 (1915)]. Energies obtained for RdTh are α_0: 5·423 MeV, α_1: 5·338 MeV, the nuclear energy diff. being 86·7 keV, and ratio of intensities $I\alpha_1/I\alpha_0 = 0{\cdot}39 \pm 0{\cdot}01$. The interpretation is not yet clear. A. O. S.

539.164 : 778.3

7241. Range distribution of the α-particles of uranium in the photographic emulsion. BOGAARDT, M. AND BOTTEMA, M. *Physica*, **15**, 358–60 (*May*, 1949) *In English.*—Ilford Nuclear Research Plates (type E_1) were soaked for 20 min in a concentrated solution of uranylacetate and dried in a cold draught for ½ hr. The statistical fluctuations of the lengths of α tracks due to U^{234} and U^{238} are presented in Gaussian curves and the standard deviations are discussed. Since α-particle tracks due to U^{235} cannot be expected to be more than 5% of the numbers of U^{234} and U^{238} no peak due to U^{235} could be detected. R. H. H.

539.164.2

7242. On the Geiger–Nuttall relationship. BISWAS, S. *Indian J. Phys.*, **23**, 51–78 (*Feb.*, 1949).—It is shown in the present work that the Geiger–Nuttall relationship is more satisfactory and refined when the $\log \lambda$, E curve is plotted for isotopes having the same atomic number Z. From the theoretical study of α-emission it has been shown that only points referring to nuclei having the same atomic number fall on a continuous curve. Even in this case there appears to be some deviation of the actual curve from the theoretical one on both ends (for nuclei having shortest and longest lives). The experimental data of all α-active nuclei have been systematically studied and the modified Geiger–Nuttall curves have been drawn for all elements from Bi to Pu. The α and β stability considerations are used to predict the probable α or β activities as yet unknown. Some of the nuclei suspected of weak α-activity are UX_1^{234}, $MsThI^{228}$ and UY^{231}. A.

539.165

7243. On the phenomena of double electronic disintegration. DAUDEL, R. AND JEAN, M. *C.R. Acad. Sci., Paris*, **228**, 662–4 (*Feb.* 21, 1949) *In French.*—The relative probabilities of a 2nd order process and two 4th order processes leading to the reaction $(A, Z) \rightarrow (A, Z\text{–}2)$ are discussed. The probability of one of these has been found, i.e. of e^--capture followed by e^+-emission. G. J. K.

539.165

7244. Note on the preparation of beta-ray sources. LANGER, L. M. Note in *Rev. Sci. Instrum.*, **20**, 216 (*March*, 1949).—Very thin backing material of low atomic number must be used to avoid distortion of the β-spectrum due to scattering. Zapon and other materials normally used for thin backings are good insulators and precautions must be taken to prevent sources from becoming charged to several kV with respect to the source chamber. Colloidal graphite can be introduced into amyl acetate solutions of Zapon to make the material a poor insulator. Zapon loaded in this manner is weakened and a sandwich construction must be used. An alternative method employs a conducting hair stretched across the backing to the earthed support frame. A synthetic resin backing is described which is not attacked when a source is deposited upon it, from an acid, alkali or alcohol solution. Certain sources break the backing material when they are being dried out. Multilayer backings are required in such cases. A process is described which avoids non-uniformity in sources deposited from solution. L. R. S.

539.16

7245. Electron-neutrino correlation in heavy ele ments. ROSE, M. E. Letter in *Phys. Rev.*, **75**, 144 (*May* 1, 1949).—The effect of the Coulomb field o the correlation is found using an approximate wave function. It may be disregarded when seeking t distinguish between the various forms of β-interaction The correlation function $F(\theta) = 1 + n\beta \cos\theta$, witho the Coulomb interaction, where θ is the electron neutrino angle and n depends on the form of inter action, is changed to $1 + nf\beta \cos\theta$, where f depend on Z, α and the electron momentum. F change from unity by only 20% for Pb. G. J. K

539.16

7246. On the theory of double β-decay. TOUSCHEK B. *Z. Phys.*, **125** (*Nos* 1–3) 108–32 (1948) *In German.*— Double β-decay is possible at 3–5 places in the periodic table, with the emission of 2 electrons, bu no neutrinos. Fermi theory is applied to this process and the mean lifetime estimated to be $\sim 10^{13}$ yr. The cross-section with vector or pseudovector coupling (or a mixture of the two) is about 100 times that fo scalar or pseudoscalar coupling. G. J. K.

539.165 : 537.533.72

Beta-ray spectrometers. *See Abstr.* 7066

539.165 : 537.533.72

Classification of the envelopes of trajectories of β-rays in an inhomogeneous magnetic field. *See Abstr.* 7067

539.165 : 537.533.72

A new type of focusing in a magnetic lens field. *See Abstr.* 7068

539.165 : 537.533.72

New application of axial magnetic fields in β-spectrometer. *See Abstr.* 7069

539.165 : 537.533.72

The electron optical properties of the focal isolation β-ray spectrometer. *See Abstr.* 7070

539.165 : 539.166

7247. Monochromatic positrons from internal conversion. LATYSHEV, G. D., GEĬ, V. V., BASHILOV, A. A. AND BARCHUK, I. F. *Dokl. Akad. Nauk, SSSR*, **63** (*No.* 5) 511–13 (1948) *In Russian.*—The theory is given in Sliv [Abstr. 7248 (1949)]. Sharp peaks were observed in the RaC′ β^+ conversion spectrum during the work reported in Abstr. 7249 (1949). It is now concluded that several of the 70 β^+ lines recorded therein were monochromatic. Spectra are shown of peaks arising from monochromatic β^+ conversion of the 1 527 keV γ-line in the K and L-shells of RaC′ and of the 1 620 keV γ-line in the M-shell. The width of the peaks corresponds to the instrumental resolution of 0·6%, down to the base-line. The radiation width of the nuclear level corresponding to the 1 527 keV γ-line is found, from the ratios of the areas under the monochromatic and continuous β^+ spectral curves, to be $\sim$ 0·5 eV. Here use has been made of Latyshev's data [*J. Exp. Theor. Phys.*, **14** (*Nos* 3–4) 65 (1944)] indicating that the 1 527 keV line is quadrupole, and of a calculation of Sliv that for such a case $w_{\Omega}^{K}/w_{\pi} = 0{\cdot}5$ [in the notation of Sliv, op. cit.]. J. C. E. J.

539.165 : 539.166

7248. The probability of formation of monochromatic positrons by internal conversion. Sliv, L. A. *Dokl. Akad. Nauk, SSSR*, **64** (*No.* 3) 321–3 (1949) *In Russian.*—Latyshev, *et al.* [Abstr. 7247 (1949)] have reported narrow intense peaks in the positron spectrum of RaC′. These are now attributed to positron conversion in an ionized atom, the electron occupying the formerly unoccupied state and the positron carrying away the whole of the remaining energy. Such monochromatic positrons will have energies exceeding the maximum of the continuous positron spectrum (for a given energy of the converted γ-quantum) by the energy of the ionized orbital level. Evidently the intensity of the monochromatic positrons depends upon the probability of ionization; it may therefore be high in cascade processes in which relatively small γ-quanta are first converted. It also depends on the ratio of the widths of the excited nuclear and the free orbital levels. The phenomenon therefore provides data on widths of nuclear levels. The ratio w_μ^K/w_π has been calculated for $\Delta W = 1{\cdot}4$ MeV, the K-shell being assumed permanently ionized; the ratio is found to be unity for a $0 \rightarrow 0$ transition, $\frac{1}{3}$ for an electric dipole and from 1 to $\frac{1}{3}$ for all other electric and magnetic multipoles. Here ΔW is the energy released in the nuclear transition, w_μ^K is the probability of monochromatic K-conversion and w_π that of pair formation. It is estimated that the intensity of monochromatic positrons from L_1 conversion may $\simeq$ that from K-conversion. J. C. E. J.

539.165 : 539.166

7249. Internal conversion of γ-radiation of RaC′: I. Positron spectrum. Geĭ, V. V., Latyshev, G. D., Pasechnik, M. V. and Tal'vik, E. V. *Izv. Akad. Nauk, SSSR, Ser. Fiz.*, **12** (*No.* 6) 724–8 (1948) *In Russian.*—An improved design of semi-circular focuser was used, with poles 300×400 mm, developed on the basis of the theory given in Geĭ and Latyshev [*J. Phys. USSR*, **10** (*No.* 5) 446–67 (1946)]. Coincidence counters were placed at 200° displacement from the source. The theoretical resolution claimed is 0·3%, down to the base line [0·6% was achieved—see Abstr. 7247 (1949)]. Current was stabilized to 0·01% for 2 000 keV, to 0·03% for 500 keV. The field was measured to 0·1% The radius of curvature of rays was 125 mm, principal slit width 0·8 mm. Source of Rn in glass ampoule 0·8 mm dia., 40 mm long, wall thickness 25 μ. Statistical error was 3 to 4% over most of the range, reduced to 2% in important parts, raised to 6% from 2·2 to 2·4 MeV. A table gives 70 ($H\rho$) values between 1 885 and 6 175 gauss cm and the corresponding energies E_β^+ in keV. For comparison, $E_\gamma = E_\beta^+ + 2\,mc^2$ is also given, together with the results of Latyshev [*J. Exp. Theor. Phys.*, **14**, 65 (1944)], Alikhanov and Latyshev [*Dokl. Akad. Nauk*, **20**, 429 (1938)] and Ellis [*Proc. Roy. Soc. A*, **143**, 350 (1934)]. The $E_\gamma = 2\,198$ keV line was found to be accompanied by lines at 2 189, 2 183 and 2 178 keV. There were indications of unresolved fine structure of the lines $E_\gamma = 1\,760$ and 2 432 keV. The positron spectrum includes several lines not found in the β^- K-conversion spectrum, those of $E_\gamma = 1\,390$, 1 835 and 2 101 keV being intense. Instances are quoted of relative differences in intensity between β^+ and β^- lines. [See Abstr. 7247 (1949) for statement that some of the 70 positron lines listed in the present paper are monochromatic]. J. C. E. J.

539.165 : 539.166

7250. Internal conversion of γ-radiation of RaC′: II. Determination of the multipolarity of lines. Geĭ, V. V., Latyshev, G. D. and Rumsh, M. N. *Izv. Akad. Nauk, SSSR, Ser. Fiz.*, **12** (*No.* 6) 729–30 (1948) *In Russian.*—The ratio, a, of the coeffs. of pair formation and of ordinary conversion in the K shell is plotted as a function of the energy of the γ-ray, for the dipole and quadrupole cases, from data of Jaeger and Hulme [*Proc. Roy. Soc. A*, **148**, 708 (1935)], Ellis and Mott [*ibid.*, **139**, 369 (1933)] and Fisk and Taylor [*ibid.*, **146**, 178 (1934)]. Experimental determinations were made with the same spectrometer and source as in paper I (preceding Abstr.). The area under each positron spectrum was determined by drawing a straight line from the origin to the peak; comparison with Jaeger and Hulme's paper suggests that the error introduced by this approximation is $< 30\%$. The values of a found for the 1 760 and 2 198 keV lines were respectively 4×10^{-2} and 7×10^{-2}, viz.: $\sim\frac{1}{2}$ the theoretical quadrupole values and $\sim\frac{1}{10}$ the theoretical dipole values. It is concluded that the lines are at least quadrupole. J. C. E. J.

539.165 : 539.166

7251. Internal conversion of γ-radiation of RaC′: III. Ratio of the coefficients of [pair to K] conversion of γ-radiation in the case of forbidden transitions. Gei, V. V., Latyshev, G. D. and Tsypkin, S. I. *Izv. Akad. Nauk, SSSR, Ser. Fiz.*, **12** (*No.* 6) 731 (1948) *In Russian.*—For the forbidden line 1 414 keV this has been calculated by Yukawa and Sakata [*Proc. Phys. Math. Soc. Japan* (*Ser.* 17) 10 (1935)] to be $\sim3\times10^{-3}$ and by Thomas [*Phys. Rev.*, **58**, 714 (1940)] to be $\sim6\times10^{-3}$, whilst for forbidden quadrupole transitions at energies $\sim3\,mc^2$ it would be $\sim2\times10^{-2}$ and in the dipole case $\sim2\times10^{-1}$. The authors determined the ratio experimentally by the means described in paper I, obtaining $a = 1{\cdot}6\times10^{-3}$. The area under the positron spectrum could not be in error by $> 50\%$. They conclude that the true value must be closer to that of the theoretical paper first quoted than to that of the second. [For correction to the present paper see Abstr. 7253 (1949)]. J. C. E. J.

539.166

7252. Fine structure of γ-lines of RaC′. Geĭ, V. V., Latyshev, G. D. and Pasechnik, M. V. *Izv. Akad. Nauk, SSSR, Ser. Fiz.*, **12** (*No.* 6) 732–9 (1948). Short version in *Dokl. Akad. Nauk, SSSR*, **63** (*No.* 3) 239–42 (1948) *In Russian.*—Fine structure of the 2 198 keV γ-line was established [Abstr. 7249 (1949)] from the positron spectrum. With the same source and apparatus, the K-conversion β^- lines corresponding to $E_\gamma = 1\,414$, 1 760 and 2 198 keV were now investigated. Graphs of these spectra are shown. The overall line widths agree satisfactorily with the above results and Latyshev [*J. Exp. Theor. Phys.*, **14**, 65 (1944)]. All 3 lines show fine structure, the

interval between components being 6·2 keV. The 1 414 keV line in addition shows a doubling of all components, of which it has 6, the doublet separation being 2·4 keV. No theory of the latter phenomenon is offered, but the 6·2 keV intervals are attributed to rotational levels of the nucleus as a whole and it is shown that this leads (assuming a spherical liquid drop model) to $R = (8{\cdot}88 \pm 0{\cdot}30)10^{-13}$ cm for the radius of the RaC′ nucleus, in satisfactory agreement with Amaldi [Abstr. 2203 (1947)]. Criticism is expressed of Guggenheimer's attempt [*Nature*, **145**, 104 (1940), Abstr. 723 (1943)] to explain certain nuclear energy levels as purely rotational, the authors preferring to regard rotation as responsible only for fine structure. The intensities of the satellite lines fall off rapidly with displacement from the fundamental transition, and more rapidly on the high than on the low energy side. J. C. E. J.

539.166

7253. The fine structure of the 1 414 keV line [of RaC′] and the question of the multipolarity of its components. Latyshev, G. D., Sliv, L. A., Barchuk, I. F. and Bashilov, A. A. *Izv. Akad. Nauk, SSSR, Ser. Fiz.*, **13** (*No.* 3) 340–6 (1949) *In Russian.*—Repetition of previous measurements [preceding Abstr.] and extension to L and M conversion, of which spectra are shown. There are 2 K series, each of 9 lines; in each the interval is $6{\cdot}0 \pm 0{\cdot}3$ keV and the relative displacement is 2·5 keV. The same holds for L and M, although, M being only at 12·8 MeV from L there is superposition. Experimental values of relative conversion probabilities are $W_K : W_L : W_{M+N+\ldots} = 5{\cdot}4 : 1 : 0{\cdot}33$. Theoretical calculations based on Yukawa and Sakata [*Proc. Phys. Math. Soc. Japan*, **17**, 306 (1935)] lead for $0 \rightarrow 0$ transition to 5·5 : 1 : 0·27. w_K/w_π depends strongly on multipolarity, where w_π is probability of pair formation [see Abstr. 7250 (1949)]. For 1 414 keV and $Z = 84$, this ratio is 8, 60, 200, 800 and 420 for electric dipole and quadrupole, magnetic dipole and quadrupole and for a $0 \rightarrow 0$ transition, respectively. The experimental value is 440. This was quoted in Abstr. 7251 (1949) as 625 [i.e. reciprocal of $1{\cdot}6 \times 10^{-3}$], an error for 550; this value has now been further reduced by more accurate measurement. It is concluded that all 18 K lines belong to the $0 \rightarrow 0$ type. That the 6 keV interval occurs in the fine structures of 1 414, 1 760 and 2 200 keV lines shows its nuclear origin, but the authors state that it is difficult to explain how such closely neighbouring and numerous levels occur. J. C. E. J.

539.166 : 537.531

Spectroscopic measurements of the X-radiation from radioactive elements. *See Abstr.* 7053

539.166 : 614.8

7254. Concrete as a protective barrier for gamma rays from radium. Wyckoff, H. O. and Kennedy, R. J. *J. Res. Nat. Bur. Stand., Wash.*, **42**, 431–5 (*May*, 1949).—For high-energy X-ray installations, it is often more economical to use concrete barriers than Pb. It has been suggested that concrete might also be useful for shielding in γ-ray installations if attenuation curves were available. The present paper presents this required information for Ra. A.

539.166.74

7255. A verification of the Klein–Nishina formula at 2·62 MeV. Ageno, M., Chiozzotto, M. and Querzoli, R. *Atti Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **6** (*Ser.* 8) 319–25 (*March*, 1949) [also *R.C. Inst. Super. Sanità*, **12** (*Nos* 4–5–6) 279–87 (1949)] *In Italian.*—The absorption of 2·62 MeV γ-rays was measured in C, Al, Cu, Sn, Pb. As the Compton absorption is $\propto Z$, pair production (for small energies) to Z^2 and the photoelectric effect to Z^4, the three separate absorption coeffs. may be obtained. The Klein–Nishina formula was found to be verified to within 1%. L. P.

539.166.74

7256. A note on the Klein–Nishina formulae for the Compton scattering of photons by electrons. Appleyard, R. K. and Allen-Williams, D. J. *Brit. J. Radiol.*, **22**, 215 (*April*, 1949).—Data are given of the cross-sections for Compton scattering of high energy photons by electrons (based on the Klein–Nishina formulae) for photons from 0·5–50 MeV. Computations from semi-empirical formulae show good agreement with theory even at energies as low as 1 MeV. R. H. H.

NUCLEAR REACTIONS 539.17

539.172

7257. Disintegration of deuterium by electron bombardment. Paul, W. *Naturwiss.*, **36** (*No.* 1) 31–2 (1949) *In German.*—An (e^-, n) process was observed with D_2O bombarded with 3·8 MeV electrons; the cross-section was estimated at 10^{-31}–10^{-30} cm^2. A. O. S.

539.172.1

7258. A peculiar activity of metals bombarded with deuterons. Chamié, C. and Filçakova, H. *C.R. Acad. Sci., Paris*, **228**, 1289–91 (*April* 11, 1949) *In French.*—Two short-period activities ($\frac{1}{2}$-lives ~ 5 and ~ 10 min) were obtained by bombarding superposed thin layers of Au with 6·5 MeV deuterons from a cyclotron; the activities decrease rapidly at first with depth, remain constant up to $\sim$ twice the deuteron range in the metal, and then decrease to zero. Similar results were obtained with Ag, Cu, Ni, Al. The effects may possibly be due to protons in the deuteron beam. A. O. S.

539.172.1

7259. Angular distribution of protons in the $N^{14}(dp)N^{15}$ reaction. Wyly, L. D. *Phys. Rev.*, **76**, 104–6 (*July* 1, 1949).—The Yale cyclotron was used to investigate the angular distributions of protons emitted in the reaction $N^{14}(d, p)N^{15}$ employing bombarding energies between 1·5 MeV and 3·0 MeV. Both the ground state and first excited state protons were studied. Over the energy range used, the protons emitted in the formation of the ground state are found to have a slightly higher yield in the forward direction while those emitted in the formation of the first excited state are essentially spherically symmetric. Neither distribution shows marked variation with energy. A.

539.172.1

7260. Relative yields of the D–D reactions at low energies. PEPPER, T. P. *Canad. J. Res. A*, **27**, 143–50 (*July*, 1949).—By the simultaneous detection of the p, T and He^3 particles in a thin window proportional counter the concurrent nuclear reactions $D(d,p)T$ and $D(d,n)He^3$ have been investigated throughout the deuteron energy range 26 to 63 keV. The ratio of the yield of the reaction $D(d,p)T$ to that of the reaction $D(d,n)He^3$ was found to be $1{\cdot}15 \pm 0{\cdot}15$ throughout this energy range. There is some slight evidence for an increase in this ratio towards lower bombarding energies. A.

539.172.1 : 539.185

7261. Neutrons from deuteron bombardment of Li^6. WHALING, W., EVANS, J. E. AND BONNER, T. W. Letter in *Phys. Rev.*, **75**, 688 (*Feb.* 15, 1949).—The excitation function for neutrons emitted at 0° was determined from 250 to 2 200 keV with natural and enriched Li, thus giving the excitation function for the separate isotopes. The angular distribution was measured at several energies for both isotopes, and also excitation functions for the competing reactions $Li^6(d,p)$ and $Li^6(d,\alpha)$. The excitation functions, after correction for the penetrabilities all indicate a broad level of width 0·5 MeV at 0·4 MeV deuteron energy. B. R.

539.172.13

7262. Short range alpha-particles from fluorine and lithium bombarded by protons. BURCHAM, W. E. AND FREEMAN, J. M. *Phys. Rev.*, **75**, 1756–7 (*June* 1, 1949). —A group of α-particles (α_2) was found from the reaction $F^{19}(p,\alpha_2\gamma)O^{16}$ corresponding to the emission of the 6·98 MeV γ-ray [Abstr. 3896 (1948)]: excited states of O^{16} are suggested at 6·94 and 7·15 MeV above the ground state. Observations of the energy ($1{\cdot}38 \pm 0{\cdot}08$ MeV) of the α-particles emitted in the reaction $Li^7(p,\gamma)Be^8 \rightarrow 2He^4$ gave the energy of the excited state of Be^8 as $2{\cdot}6 \pm 0{\cdot}2$ MeV, width $0{\cdot}9 \pm 0{\cdot}1$ MeV. A. O. S.

539.172.3

7263. The angular distribution of the photo-disintegration of the deuteron. WOODWARD, W. M. AND HALPERN, I. *Phys. Rev.*, **76**, 107–13 (*July* 1, 1949).—The distribution of protons from the photo-disintegration of the deuteron was measured in detail as a function of the angle at an energy of 0·48 MeV above the threshold. The observed angular distribution agreed with the prediction of the theory. Measurements of the variation of the angular distribution with energy agreed qualitatively with the theory but seemed to give too high a value for the ratio of photomagnetic to photoelectric disintegration cross-sections. A.

539.172.3

7264. The photo-disintegration of oxygen into four alpha-particles. GOWARD, F. K., TITTERTON, E. W. AND WILKINS, J. J. *Proc. Phys. Soc., Lond. A*, **62**, 460 (*July*, 1949).—Stars consisting of 4 α-particles were observed in photographic plates irradiated with γ-rays (energy extending to 23 MeV) from a synchrotron. Measurement of the energy released and momentum balance suggest the reaction $O^{16} \rightarrow 4He^4 - 14{\cdot}6$ MeV. The mean cross-section for γ energies 20·5–23 MeV is given as 2×10^{-29} cm², on the basis of ionization measurements and a theoretical γ-spectrum for the synchrotron. T. G. P.

539.172.3

7265. Evidence for the photo-fission of uranium into three charged fragments. TITTERTON, E. W. AND GOWARD, F. K. Letter in *Phys. Rev.*, **76**, 142 (*July* 1, 1949).—4 cases of photo-fission into 3 charged fragments have been recorded in photographic plates impregnated with uranium acetate and irradiated by 23 MeV γ-rays from a synchrotron. An examination of the tracks indicates, in each case, that there are 2 heavy fragments and a high energy α-particle. A preliminary value of one ternary fission to 400 ± 200 binary fissions is indicated. The possibility that the observed events were due to neutrons is discounted. L. R. S.

539.172.3

7266. In^{118} and In^{119} produced by photo-disintegration of tin. DUFFIELD, R. B. AND KNIGHT, J. D. Letter in *Phys. Rev.*, **75**, 1967–8 (*June* 15, 1949).—Irradiation of Sn with 23 MeV betatron X-rays produced 4·5 min and 17·5 min periods attributed to the reactions $Sn^{119}(\gamma,p)In^{118}$ and $Sn^{120}(\gamma,p)In^{119}$ respectively. An absorption curve on In^{118} (produced in a target enriched in Sn^{119}) gave 1·5 MeV β, and $\sim 3\%$ γ background. In^{119} from an enriched Sn^{120} target was precipitated as hydroxide; an absorption curve gave 2·7 MeV β^- and γ background $< 0{\cdot}1\%$. T. G. P.

539.172.3

7267. The ejection of protons from nuclei by gamma-rays. JENSEN, P. *Naturwiss.*, **35** (*No.* 6) 190 (1948) *In German.*—Experimental values [Abstr. 188 (1948)] $\geqslant$ the statistical theory [Abstr. 1507 (1940)] predicts, of the ratio of (γ,p) to (γ,n) cross-sections for medium elements with 17 MeV neutrons can be explained by direct interaction between the γ-ray and a proton near the surface of the nucleus, before the energy is shared with the other nucleons. A. O. S.

539.172.4

7268. Slow neutron cross sections of the neodymium isotopes. HESS, D. C., JR. AND INGHRAM, M. G. Letter in *Phys. Rev.*, **76**, 300 (*July* 15, 1949).—Samples of normal Nd and Nd which had been given a long slow neutron irradiation were examined in a 60° direction focusing mass spectrometer. Comparison of the isotopic abundances revealed in the irradiated sample a considerable depletion of the isotope 143 and a corresponding increase in the isotope 144. An isotopic cross-section of 240 b was assigned to Nd^{143}, at least 6 times the value of any of the other isotopes. L. R. S.

539.172.4

7269. Distribution in mass and charge of fission products. KINGDON, K. H. Letter in *Phys. Rev.*, **76**, 136 (*July* 1, 1949).—It is suggested that the two fission fragments are formed in such a way as to produce the greatest stability in the binding of the excess neutrons. The ability of a nucleus to bind neutrons may be measured by the quantity $(A-Z)/Z$ and as this is generally greater for the even Z nuclei it is suggested that fission takes place into even Z fragments. A plot of $[(A_1-Z_1)/Z_1] + [(A_2-Z_2)/Z_2]$

against Z with $Z_1 + Z_2 = 92$ gives a central minimum at $Z = 46$ which corresponds fairly well to the observed min. at $A = 117$ on the fission product abundance curve. Two prominent humps in the stability curve on either side of $Z = 46$ correspond equally well to the humps in the abundance curve.

L. R. S.

539.172.4

7270. On the sticking probability of fast neutrons in the nuclear reactions. MUTO, T. AND NOGAMI, M. *J. Phys. Soc. Japan*, **2**, 138–42 (*Sept.–Oct.*, 1947) *In English.*—The cross-section $\sigma(E_0)$ of a nuclear reaction produced by an incident particle of energy E_0 can be expressed as a product of a cross-section $\sigma_f(E_0)$ for the formation of the compound nucleus and a factor giving the probability of disintegration into the given reaction products. $\sigma_f(E_0)$ may, in turn, be given as a product of a penetration probability and the sticking probability of the particle. The computation of the latter factor is discussed and the sticking probabilities of fast neutrons in the range 2·25 MeV to 3 MeV are calculated for a number of nuclear species from available data on the total neutron cross-sections of these nuclei. The calculated values show a general increase with incident neutron energy and are all less than 0·2 in the energy range covered.

L. R. S.

539.172.4

7271. Fission cross-section of uranium^{235} for thermal neutrons. BISWAS, S. AND PATRO, A. P. *Indian J. Phys.*, **23**, 97–106 (*March*, 1949).—The cross-section of fission of U^{235} for thermal neutrons has been determined in the present work. The Cu cathode of a proportional counter was coated with electrolytically deposited U-compound which was converted to U_3O_8 by heating. The exact amount of U was determined by accurate weighing. The fission counter and a Ra–Be neutron source were placed inside a large paraffin block. Operating the counter in the proportional region large fission pulses were detected against a background of natural α-ray pulses, with usual amplifier, discriminator, scaling and recording circuits. In order to separate the effects of thermal neutrons, the observations were taken with and without a $\frac{1}{2}$ mm Cd-shield round the counter and the difference gives the rate of thermal neutron fissions, which are ascribed to U^{235} isotope. To measure the neutron flux a BF_3 counter of identical dimensions was placed in the same position in the paraffin block as the fission counter and the number of thermal neutrons was counted with the Cd-difference method. Using the well-known value of $\sigma_a v$ for boron, the value of $\sigma_f v$ was obtained. Hence $\sigma_f(U^{235})$ for thermal neutrons was determined as $(526 \pm 10) \times 10^{-24}$ cm^2.

A.

539.172.4

7272. Uranium 235 in thucholite. ORR, J. B. Letter in *Phys. Rev.*, **76**, 155 (*July* 1, 1949).—It is suggested that a sufficient mass of the U and Th bearing mineral thucholite could, through the moderating action of the large carbon content, have undergone a fission chain reaction, with resulting depletion of the U^{235}. Samples of U_3O_8 prepared from this mineral and from uraninite were examined in a given thermal neutron flux. Preliminary results have indicated a lower fission rate in the U from thucholite.

L. R. S.

539.172.4

7273. Transformation of chlorine 35 by thermal neutrons with emission of protrons. MAURER, W. *Z. Naturforsch.*, **4a** (*No.* 2) 150–2 (*May*, 1949) *In German.*—By fast neutron bombardment of NaCl enriched in Cl^{37}, the 88 d S isotope was shown to be S^{35}, from $Cl^{35}(n,p)S^{35}$; this reaction also occurs for thermal neutrons with a cross-section of 0·29(± 25%) barns. The reaction $Zn^{64}(n,p)Cu^{64}$, also theoretically possible with thermal neutrons, has a cross-section $< 10^{-5}$ barns.

A. O. S.

539.172.4

7274. On the energy loss by fission fragments along their path. LASSEN, N. O. Letter in *Phys. Rev.*, **75**, 1762–3 (*June* 1, 1949).—The specific ionization in gases produced by fission fragments decreases almost linearly over the last section of the range over which this ionization is measurable. Extrapolation of the linear region of the ionization leads to a range which is considerably lower than the total range observed in recent cloud chamber measurements [Abstr. 1617 (1947)]. Theoretical considerations account for this, on the assumption that the fragments are slowed down initially, by ionizing encounters with electrons, as a consequence of their high charge. At the extrapolated range the fragments have become almost neutral as a result of electron capture and subsequent energy loss occurs mainly by nuclear collisions with negligible production of ions. Energy loss in this region can be calculated by Bohr's formula and the results combined with the observed ionization curve to give the complete energy loss curve. Various aspects of the slowing-down process calculated on the above basis are found to agree well with experimental results.

L. R. S.

539.172.4

7275. A method employing the fission of U^{235} to analyse the uranium content of minerals. FACCHINI, U. AND ORSONI, L. *Nuovo Cim.* (*Ser.* 9) **6**, 241–54 (*July*, 1949) *In Italian.*—The number of impulses per unit time generated in an ionization chamber by fission products of a layer of a granulated U compound irradiated with thermal neutrons is calculated. The number of impulses is $\propto$ the weight percentage of U, to the density of the compound and to the range of U^{235} fission products in the compound. By measuring impulses from a known U compound, the U content of any U compound may be determined by comparison. The experimental apparatus is described, with which measurements were made confirming the above deductions.

A.

539.172.4

7276. Derivation and integration of the pile-kinetic equations. HURWITZ, H., JR. *Nucleonics*, **5**, 61–7 (*July*, 1949).—The equations which describe the changes with time of (*a*) fission rate, in terms of the multiplication factor for prompt neutrons and the numbers of prompt and delayed neutrons appearing per sec in the pile, and (*b*) the numbers of excited nuclei giving delayed neutrons with a certain period, are derived. They are solved for (*a*) steady state, (*b*) permanent change in pile reactivity within a time

$<$ any delayed neutron period. An approx. solution is obtained for the case when the reactivity changes continuously at a slow rate; it is shown in an example to agree well, throughout a period in which the pile power increases by a factor 10^8, with the result obtained by numerical integration of the pile equations. A. P. F.

539.172.4 : 539.163.2

7277. Neutron capture γ-rays from Cd. Moak, C. D. and Dabbs, J. W. T. Letter in *Phys. Rev.*, **75**, 1770–1 (*June* 1, 1949).—Capture γ-rays from a Cd target placed in a pile neutron beam were allowed to fall on a Pb foil, in a cloud chamber, with 1 400 V applied magnetic field. Positron-electron pair tracks were photographed and the γ-ray energy spectrum deduced from the observed pair spectrum. 20% of the exposures were made with a B shutter in front of the Cd to allow for possible fast neutron effects. The high energy tail of the γ spectrum was found to extend to 8·7 (± 0·6) MeV. L. R. S.

539.172.4 : 539.164

7278. Angular correlations in successive nuclear α-γ-emission and excited state of Li^7. Feld, B. T. Letter in *Phys. Rev.*, **75**, 1618–19 (*May* 15, 1949).—The angular correlation between α-particle and γ-ray emitted in the $B^{10}(n, \alpha)Li^7$ reaction is discussed in the light of the various level schemes, which have been suggested for the ~480 keV state of Li^7. Experiments are being undertaken to determine the angular correlation with a view to distinguishing between the possible level schemes. [See also Abstr. 7194 (1949)]. L. R. S.

539.172.4 : 621.039.422

7279. The uranium reactor and its application as energy source. Hæffner, E. *Tekn. Tidskr.*, **79**, 261–6 (*April* 9, 1949) *In Swedish.*—The principles of U fission are outlined, capture and dispersion cross-section and resonance capture being defined. Tables give values of cross-sections for various substances and moderator characteristics of some elements. Neutron balance in chain-reaction systems is discussed and an example of design of a homogeneous reactor is given. Control and regulation and some technical problems are discussed. J. A. W. (R)

ATOM AND MOLECULE BEAMS . MESONS NEUTRONS 539.18

539.18

7280. Multiple scattering with energy loss. Foldy, L. F. Letter in *Phys. Rev.*, **75**, 311–12 (*Jan.* 15, 1949).—Curves are derived to enable the masses of heavy particles to be measured from their multiple scattering in Ilford "nuclear research" emulsions. U. C.

539.18

7281. Note on the slowing down of mesons. Mott, N. F. *Proc. Phys. Soc., Lond. A*, **62**, 136 (*Feb.*, 1949).—A calculation of the rate of loss of energy of slow mesons passing through a metal, by a treatment similar to the analogous problem of the electrical resistance of alloys is shown to yield substantially the same result as that obtained by Fermi, Teller and Weisskopf [Abstr. 1634 (1947)]. U. C.

539.18

7282. Current ideas about mesons. Snyder, C. W. *Nucleonics*, **5**, 42–52 (*July*, 1949).—The accumulated evidence for the existence of mesons of ~200, 300 and 1 000 electron masses is reviewed, and the various modes of formation and decay are discussed (chiefly in the light of photographic plate studies). It is considered that the evidence for a λ-meson (3–10 m_e) is inconclusive. A. P. F.

539.18

7283. Comment on the nuclear capture of negative mesons. Barnothy, J. Letter in *Phys. Rev.*, **76**, 303 (*July* 15, 1949).—Points out that the binding energy of a negative μ-meson in the K orbit in Pb being 38·6 MeV, interpretations of the absence of decay electrons from μ-mesons stopping in Pb are modified. E. P. G.

539.18

7284. On the relativistic variance of π mesons. d'Espagnat, B. *C.R. Acad. Sci., Paris*, **228**, 744–6 (*Feb.* 28, 1949) *In French.*—Assuming the spin of the μ-meson to be $\frac{1}{2}$, and that the interactions π-μ and π-nucleon are direct, values are calculated for the μ-decay and β-decay of vector π-mesons. The calculations are repeated for pseudo-scalar π-mesons. The experimental results are considered to support the view that π-mesons are pseudo-scalar. E. P. G.

539.18

7285. Varitrons. Papkow, A. *Phys. Bl.*, **5** (*No.* 5) 206–10 (1949) *In German.*—Reviews the work of Alikhanyan, *et al.* E. P. G.

539.18

7286. Observations of varitrons of different masses on photographic plates. Alikhanyan, A. I., Samoilovich, D. M., Gurevich, I. I., Babayan, Kh. P. and Geragimova, R. I. *J. Exp. Theor. Phys., USSR*, **19**, 664–6 (*July*, 1949) *In Russian.*—The numbers of grains, N, in a length of track, R, have been counted for a series of isolated tracks that have been found in plates sensitive to 50 MeV protons, exposed at a height of 3 860 m for periods of 14, 17 and 40 d. By plotting N against R, a family of curves lying both above and below that for the proton is obtained. These curves are taken to show the existence of particles of the following masses: 180–200, 320–350, 650–700, 950–1 000, 3 500–4 000, 8 000–10 000 times that of the electron. These results are alleged to agree with the significant masses of individual varitrons established by the method of magnetic analysis. E. P. G.

539.18

7287. Disintegration of heavy varitrons. Alikhanyan, A. I., Samoilovich, D. M., Gurevich, I. I. and Babayan, Kh. P. *J. Exp. Theor. Phys., USSR*, **19**, 667–70 (*July*, 1949) *In Russian.*—The majority of the varitrons ending in the photographic emulsion (see previous Abstr.) are not observed to give rise to secondary particles, but 3 varitrons have been observed to do so. Grain counts performed on lengths of these tracks, $<$ 300 microns, are compared with those for protons. The following results are given: (1) primary 4·5 m_p, secondary ? ; (2) primary

and secondary $\sim m_p$; (3) primary 750–800 m_e, secondary 200 m_e (m_p = mass of proton, m_e = electron mass). E. P. G.

539.18 : 530.145

7288. The interaction of point particles with charged fields. Le Couteur, K. J. *Proc. Camb. Phil. Soc.*, **45** (*Pt* 3) 429–40 (1949).—A classical theory of a charge-symmetric vector meson field is developed as in the classical electron theory of Dirac [Abstr. 3660 (1938)]; [for neutral meson field, see Abstr. 2192 (1941)]. Using this theory, the cross-sections for nuclear scattering of charged mesons by protons or neutrons are obtained. They depend on a constant similar to the isotopic spin inertia in strong coupling theory. A brief comparison is made between with the results of the Heitler radiation damping method. G. J. K.

539.18 : 537.533.74

The Compton scattering by particles possessing charge and dipole moment. *See Abstr.* 7074

539.18 : 537.591

Mean life considerations in relation to curvature of cosmic-ray paths in a magnetic field. *See Abstr.* 7128

539.18 : 539.172

7289. Disintegration of helium by π^--mesons. Ruddlesden, S. N. and Clark, A. C. Letter in *Nature, Lond.*, **164,** 487–8 (*Sept.* 17, 1949).—A critical experiment on the nucleon/meson interaction would be the nuclear absorption of π^--mesons by He. The relative probabilities that the resulting singly-charged particle be a triton, deuteron or proton are given for certain types of possible interaction. The theoretical energy spectra of the protons are also plotted. E. P. G.

539.18

7290. H^3 and the mass of the neutrino. Bowers, W. A. and Rosen, N. Letter in *Phys. Rev.*, **75,** 523 (*Feb.* 1, 1949).—It is pointed out that the latest measurements of the ½-life and max. β-energy of tritium [Abstr. 718, 3887 (1948)] remove the need to assume a non-zero neutrino mass [Abstr. 184 (1948)]. A. P. F.

539.181

7291. The scattering of high velocity neutral particles. I. Amdur, I., Glick, C. F. and Pearlman, H. *Proc. Amer. Acad. Arts Sci.*, **76,** 101–19 (*Oct.*, 1948).—A detailed description of construction and performance is given for an apparatus which has (*a*) a low voltage ion source and accelerating system in which particles can be accelerated to 200–2 000 eV and then neutralized, (*b*) a scattering chamber, the pressure in which can be measured with a Pirani gauge, furnished with an entrance hole (0·020 in dia.) and an exit slit of adjustable width, and (*c*) thermocouple or bolometer detectors, with responses between ~ 2 and 100 V/W, that can be moved along the length of the slit in steps of 0·001 in. Curves are shown for the intensity distribution across beams of He atoms scattered in He at 1 000 and 1 200 eV. A. P. F.

539.181 : 537.534

7292. An arrangement for focusing electrically neutral particles. Vauthier, R. *C.R. Acad. Sci., Paris,* **228,** 1113–14 (*March* 28, 1949) *In French.*—Herzog [*Zeits. für Phys.*, **89,** 447 (1934)] showed that between the plates of a cylindrical condenser a monoenergetic beam of ions can be focused. An analogous arrangement is now proposed for particles having a magnetic dipole moment, which may be focused in a curved region in which the gradient of the magnetic field is constant. For particles having a magnetic moment of one Bohr magneton the radius of curvature of the trajectories is 52 000 $T/(\partial H/\partial X)$ where T is the absolute temp. and the particles have the most probable thermal velocity. Such an arrangement would facilitate the investigation of the distribution of thermal velocities. Expected difficulties include the attainment of a uniform $\partial H/\partial X$ over 2 or 3 mm of air gap, and of a value of $\partial H/\partial X$ sufficiently great for the size of the electromagnet not to become prohibitive. Application would be confined to molecules having one Bohr magneton moment. J. C. E. J.

539.181.2

7293. Production and measurement of an intense beam of hydrogen molecules. Nöller, H. G., Oetjen, G. W. and Jaeckel, R. *Z. Naturforsch.*, **4a** (*No.* 2) 101–4 (*May*, 1949) *In German.*—The production of a molecular beam of high intensity of a gas is a problem of the production efficiency of the diffusion pump. In order to produce an intense beam of H molecules it was necessary to use a diffusion pump with a pumping rate 3 000 l/sec in order to extract the molecules through a slit in the furnace (5×2·4 mm), and a second diffusion pump with a pumping rate of 300 l/sec at the collimating slit measuring 7·5×3·5 mm. At the point of observation of a beam of cross-section 4×10 mm², a maximum current of particles of $3\cdot6\times10^{12}$ molecules/sec was obtained. F. LL. J.

539.185

7294. Note on the scattering of neutrons by $_2He^4$. Nogami, M. *J. Phys. Soc. Japan*, **1,** 11–12 (*July.–Dec.*, 1946) *In English.*—Corrections are given to earlier work on *S*-wave scattering [*Proc. Math. Phys. Soc. Japan*, **24,** 26 (1942)]. The *P*-wave scattering is also considered using simplified self-consistent wave-functions, but a poor approx. is obtained for energies up to 7 MeV owing to resonance effects. G. J. K.

539.185

7295. On the theory of the slowing down of neutrons. Bothe, W. *Z. Phys.*, **125** (*Nos* 1–3) 210–24 (1948) *In German.*—Isotropic scattering in an infinite non-capturing medium is assumed. Rigorous and asymptotic expressions are obtained for (*a*) the energy distribution of neutrons that have suffered n collisions, (*b*) the energy distribution of all neutrons, (*c*) the slowing down length, assuming that the mean free path is independent of energy, and that the energy loss in an elastic collision is statistically independent of the direction of scattering. A. P. F.

539.185

7296. On the elastic scattering of neutrons by deuterons. Verde, M. *Helv. Phys. Acta*, **22** (*No.* 3) 339–60 (1949) *In English.*—A formalism is set out for calculating the scattering, and a variation method given, similar to that of Hulthen in n–p scattering, for

the calculation of the phase at low energies neglecting the perturbation of the deuteron. Preliminary calculations using a symmetric potential with Gaussian functions shows a pronounced backward scattering at 20 MeV and at lower energies. G. J. K.

539.185

7297. Diffraction effects in the scattering of fast neutrons. Amaldi, E., Bocciarelli, D., Cacciapuoti, B. N. and Trabacchi, G. C. *R.C. Ist. Super. Sanità*, **9** (*Pt I*) 5–13 (1946) *In Italian.*—See Abstr. 2945 (1946), 1962 (1947) and Report of Cambridge Conference on Fundamental Particles (*Phys. Soc., Lond.*, 1947, 97–113). A. P. F.

539.185

7298. Determination of the mean number of collisions suffered by a thermal neutron in water before capture. Cortini, G. and Molina, F. *R.C. Ist. Super. Sanità*, **9** (*Pt I*) 14–26 (1946) *In Italian.*—A Ra–Be source was oscillated vertically along the axis of a cylindrical tank of water (70 cm high, 52 cm dia.) to produce a neutron distribution having cylindrical symmetry. Using Rh detectors, the radial distribution of neutron density $n_0(r)$ was measured outwards from the surface of a hollow Al cylinder, of outer radius $R = 3{\cdot}1$ cm, placed with its axis along the axis of the tank. The Al cylinder was replaced by a geometrically identical one of Cd, and the density $n(R)$ at its surface was measured. From $n(R)$, $n_0(R)$ and $n_0'(R)$ the mean number of collisions before capture could be evaluated and was found to be 127 ± 5. Taking the scattering cross-section of H_2O for thermal neutrons to be 46·7 barns, the capture cross-section of H is obtained as 0·367 barns. A. P. F.

539.185

7299. On the relativistic generalization of the integro-differential equation of neutron diffusion. Dràganu, M. *C.R. Acad. Sci., Paris*, **228**, 367–8 (*Jan.* 31, 1949) *In French.*—By considering the invariance under a Lorentz transformation of the number of particles in a volume element, the diffusion equation for neutrons undergoing capture and isotropic elastic scattering [Abstr. 866 (1938)] is obtained in relativistic form. A. P. F.

539.185

7300. Introduction to the theory of diffusion and slowing down of neutrons. I. Marshak, R. E., Brooks, H. and Hurwitz, H., Jr. *Nucleonics*, **4** (*No.* 5) 10–22 (*May*, 1949).—The diffusion equation for slow neutrons is derived from the Boltzmann equation under the assumption that their distribution in direction at any point has the approx. form $A + B\cos\theta$. A rigorous solution of Boltzmann's equation is then given, and it is shown that the approx. solution is valid if (*a*) the point considered is far from sources and from any regions (especially boundaries) in which the properties of the medium change appreciably within a mean free path; and (*b*) probability of capture is $\ll$ probability of scattering. It is shown that there is no loss of generality in solving Boltzmann's equation in 1 dimension, i.e. for a plane source; solutions of this type are then obtained for infinite and semi-infinite media. The corrections to diffusion theory required near boundaries are discussed, and the value of imposing the extrapolated end-point condition in finding constants that appear in the integrated equations is illustrated by examples. A. P. F.

539.185

7301. Introduction to the theory of diffusion and slowing down of neutrons. II. Marshak, R. E., Brooks, H. and Hurwitz, H., Jr. *Nucleonics*, **4** (*No.* 6) 43–9 (*June*, 1949).—This paper deals with improvements on the simple diffusion theory [preceding Abstr.]. The use of an expansion of the density-direction function in spherical harmonics up to any desired order is illustrated by a solution of the Boltzmann equation for a system composed of a slab of fissile material with a semi-infinite non-multiplying medium on each side. It is assumed that the mean free path is the same in both media, and that there is only one neutron velocity throughout. The essentials of the integral equation method are outlined (again for one velocity only); the form of the solution is given for the general case where the source strength may be time-dependent and the relative amounts of scattering, absorption and fission may vary from place to place. The relation between solutions for plane and spherical geometries is indicated. The variational and Wiener–Hopf methods for obtaining solutions to the integral equation are described. A. P. F.

539.185

7302. Theory of diffusion and slowing down of neutrons. III. Marshak, R. E., Brooks, H. and Hurwitz, H., Jr. *Nucleonics*, **5** (*No.* 1) 53–60 (*July*, 1949).—The form of the Boltzmann equation is obtained for the case in which neutrons of a single initial energy are slowed down in a homogeneous medium, assuming that (*a*) inelastic scattering does not occur, (*b*) the effects of chemical binding can be ignored (it is shown that this is so if the neutron energy is $>$ the binding energy), and (*c*) the elastic scattering is isotropic in the centre of mass system. By considering the stationary state, and assuming a nearly isotropic distribution of directions (1st 2 terms only in a spherical harmonic expansion) for any position and energy, the age equation is derived. Its Laplace transform is shown to be formally the same as the diffusion equation with capture. A. P. F.

539.185

7303. Angular distribution of the scattering of slow neutrons by deuterium gas. Spiers, J. A. *Nat. Res. Coun. Can. Publ.* (*CRT*417) 33 (1949) [see letter in *Phys. Rev.*, **75**, 1765 (*June* 1, 1949) for summary].—An expression is derived for the differential cross-section $\bar{\sigma}(\theta')$ of scattering of slow monokinetic neutrons by D molecules referred to axes at rest. The thermal velocities of the molecules are taken into account. Partial cross-sections are derived for given transitions $J \rightarrow J'$ in the molecular rotational states and the resultant $\bar{\sigma}(\theta')$ obtained by summing over the final states and averaging over the initial states weighted for the given gas temp. Results are computed for an initial neutron energy of 0·07 eV and a gas temp. of 70°K. It is suggested that a comparison of the computed $\bar{\sigma}(\theta')$ with the angular distribution measured experimentally, should yield possible values of the ratio of the scattering lengths for the doublet

and quadruplet states of the neutron-deuteron interaction. A semi-classical model in which the incident neutron is scattered by 2 deuterons at a given distance apart, is shown to give partial differential cross-sections in good agreement with those calculated by the rigorous theory, for angles θ' up to 40°. At higher angles the agreement is poorer, the quantum-mechanical cross-sections being only $\frac{2}{3}$ of the semi-classical values at $\theta' = 180°$. L. R. S.

539.185

7304. Preparation and use of neutron sources. McCallum, K. J. *Nucleonics*, **5** (*No.* 1) 11–21 (*July*, 1949).—The essential data on yields and energies for different types of source are summarized. Details of construction are shown for typical (α,n) and (γ,n) sources. Health precautions, particularly against γ-rays, are indicated. A. P. F.

539.185.75 : 778.3

7305. On the measurement of the energy of fast neutrons by photographic emulsions loaded with enriched Li^6. Keepin, G. R. and Roberts, J. H. Letter in *Phys. Rev.*, **76**, 154 (*July* 1, 1949).—In commercial Li-loaded nuclear emulsions the disintegration of Li^6 by neutrons into an α-particle and a triton is masked by a high background of proton tracks. This difficulty has been overcome by loading emulsions with enriched Li^6. This isotope with an enrichment factor of about 98% was used for impregnating Kodak NTA emulsions. An analysis of this method using a Po–Be source indicates that it can be applied to measure neutrons of energy < 1 MeV to a precision of $\pm 0{\cdot}1$ MeV. The neutron energy is determined from an accurate measurement of the sum of the ranges of the α-particle and the triton and the angle between the two particles. R. H. H.

539.185

7306. Influence of a small black cylinder upon the neutron density in an infinite non-capturing medium. Seidel, W. P., Davison, B. and Kushneriuk, S. *Nat. Res. Coun. Can. Publ.* (*No.* 1868) 74 *pp.* (1948).—The neutron density in a uniform non-capturing medium surrounding a long black cylinder of a small radius, in the case where the density depends only upon the distance from the cylinder, is examined. The linear extrapolation length λ for the asymptotic solution for the density in the surrounding medium is determined and expressed in terms of the radius of the cylinder. The method used can be treated as the iteration method, with the zero approximation corresponding to the case when the cylinder has zero radius, i.e. as the zero approximation a constant density is taken throughout the infinite space. The correction due to the presence of the cylinder, though small at a finite distance, is large both at very small and at very large distances from the cylinder, and is particularly large at large distances. However, it is shown that the main part of the effects of the presence of the cylinder is contained already in the first iteration, so that the corrections appearing in the further iterations can be treated everywhere as small perturbations. The expression for the linear extrapolation length λ is

$$\lambda = 4/3 + \left(1 - \frac{16}{3\pi^2}\right) a \log a - 0{\cdot}2164a + 0(a^2 \log^2 a)$$

in which a is the radius of the infinitely long cylinder in units of the external mean free path, and the linear extrapolation length is also expressed in the units of the external mean free path. A.

539.185 : 530.145

7307. Relativistic scattering of neutrons by protons. Basu, D. *Proc. Roy. Irish Acad.*, **52 A** (*No.* 10) 127–41 (*June*, 1949).—Partial and total cross-sections are obtained relativistically in Born approx. using vector and pseudoscalar fields of various types and mixtures. The effect on these is found when terms are introduced in the Hamiltonian to eliminate singular δ-type terms in the "static" interaction potential. The cross-section $\propto$ (neutron momentum)^2 at very high energies when either r^{-3} or δ-type terms occur in the interaction, and mixtures of the Møller–Rosenfeld type do not eliminate the difficulty, since they only cancel the singularities in the static interaction, and not in the velocity-dependent terms. G. J. K.

STRUCTURE OF SOLIDS 539.2

539.211

7308. Study of surface granulations on plastically deformed metals. Hérenguel, J. and Scheidecker, M. *Rev. Métall.*, **46**, 538–43 (*Aug.*, 1949) *In French.*—Relates "orange-peel" effect to crystal size and orientation. The distribution of slip lines is discussed as a means of assessing orientation. It is concluded that the effect is not shown by fine-grained metals which are completely disoriented. N. F. A.

539.215.4

7309. On grain-size distribution in pulverization processes. Koppe, H. *Nachr. Wiss. Göttingen* (*No.* 2) 119–22 (1946) *In German.*—A theoretical derivation of the formula $n(x,t) \simeq \text{const.}\ \varepsilon^{-t\bar{\sigma}(x)}$, where $n(x,t)$ is the number of particles of size x after pulverization has continued for time t, and $\bar{\sigma}(x)$ is a function approx. $\propto$ the mass of the particle. This result is almost independent of the method of pulverization used. N. C.

539.23

7310. On the irreversible effect of gaseous adsorption on very thin metallic films. Mostovetch, N. *C.R. Acad. Sci., Paris*, **228**, 1850–2 (*June* 13, 1949) *In French.*—Describes expts. on metallic films deposited in a "very high" vacuum and not vacuum baked, whose resistance changes on exposure to various gases (press. $> 10^{-4}$ mm Hg) were measured. The gases used (N_2, O_2, H_2, CO_2 and He) usually produced a decrease in resistance, often of several powers of 10 in size compared with the initial resistance. The films studied were of Mo, Au, Pt, Ta and W. Certain effects caused by heating and cooling cycles are briefly described. J. D. C.

539.26 : 620.179.15

7311. X-ray examination of materials and application to shipyard welding. Heal, T. J. *Research, Lond.*, **2**, 119–26 (*March*, 1949).—The principles and technique of the detection of flaws in metals by radiography are described. Factors such as

definition and contrast which are relevant to the production of good radiographs are discussed, together with the interpretation of the results. An account of the defects commonly found in welded structures is given, and the value of X-ray examination is assessed. M. R. H.

539.264

7312. X-ray determination of the ratio of crystalline to amorphous material in cellulose fibres. FLASCHNER, L. *Ann. Phys., Lpz.* (*Folge* 6) **2**, 370–92 (1948) *In German.*—Describes a method involving the measurement of the relative proportions of the incident X-ray beam that are scattered into the diffraction peaks and into the background respectively. The contribution of the amorphous part of the material is calculated according to the standard formulae for X-ray diffraction by liquids. J. T.

539.27

7313. Experiences in the application of electron diffraction to the examination of solid bodies. FORSTER, R. AND BRANDENBERGER, E. *Schweiz. Arch. angew. Wiss. Tech.*, **15**, 215–24 (*July*, 1949) *In German.*—A general account of the electron diffraction method, including the description of a cold cathode type camera, and an assessment of the value of the method in the examination of single crystal, polycrystalline and amorphous specimens, and in the identification of surface layers and thin films. Various specimen patterns are shown. M. R. H.

539.27

7314. Electron-diffraction study on behaviors of metals deposited on crystal surfaces. I. Metals deposited on galena. MIYAKE, S. AND KUBO, M. *J. Phys. Soc. Japan*, **2**, 15–19 (*Jan.–April*, 1947) *In English.*—Cu was evaporated on to a freshly cleaved crystal of galena in the electron diffraction camera, and the pattern observed while the specimen was heated up to 500°C, the initial temp. being between room temp. and this value. Similar experiments were made with Fe and Ni. At lower temps. the pattern of the vaporized metal with or without preferred orientation was obtained. At higher temps. more complicated phenomena occurred. When Cu was deposited on the surface between 180° and 300°C a Pb spot pattern appeared which changed into a ring pattern and gradually disappeared, leaving Cu or Cu_2O rings. The patterns of various oxides and sulphides were observed. The formation of oxides is not attributed to residual air in the apparatus, but to O contained in the galena. The observed phenomena are explained on the basis of the diffusion of atoms from the surface into the body of the crystal. M. R. H.

539.27

7315. Electron diffraction study on behaviors of metals deposited on crystal surfaces. II. Diffusion phenomena of metal atoms on galena. MIYAKE, S. AND KUBO, M. *J. Phys. Soc. Japan*, **2**, 20–4 (*Jan.–April*, 1947) *In English.*—The electron diffraction patterns obtained from evaporated Cu and Ag films on galena crystals gradually fade. The theory of the diffusion of metal atoms into the underlying crystal is considered, and it is shown how the diffusion coeff. D may be determined by observing the time taken by the pattern to disappear. Account is taken of the fact that the crystal may not be uniformly covered by the deposited metal. The variation of D with temp. is discussed and some experimental results are given for Cu and Ag. M. R. H.

ELASTICITY . STRENGTH . RHEOLOGY
539.3/.8

539.31

7316. Elasticity beyond the elastic limit. REINER, M. *Amer. J. Math.*, **70**, 433–46 (*April*, 1948).—The author distinguishes between "deformation" and "strain," denoting by strain that part of a deformation which is recovered when all external forces are removed; however, his work applied equally to those cases when the so-defined strain and deformation are identical. On the assumption that there is a one-to-one relation between the stress tensor and the strain tensor it is shown that this relation can be expressed in the forms

$$T_r^s = (F_{01}I_e + F_{02}II_e + F_{03}III_e)\delta_r^s + F_1 e_r^s + F_2 e_\alpha^s e_r^\alpha$$
$$e_r^s = (\Phi_{01}I_T + \Phi_{02}II_T + \Phi_{03}III_T)\delta_r^s + \Phi_1 T_r^s + \Phi_2 T_\alpha^s T_r^\alpha$$

where I_e, II_e, III_e, are invariants of the strain tensor, I_T, II_T, III_T, are invariants of the stress tensor, the F's are functions of the strain invariants and the Φ's are functions of the stress invariants. The above relations are independent of any particular measure of strain, and the author chooses the Hencky (or logarithmic) measure in expanding his theory. By considering certain special types of stress fields the F's are given meanings as generalized moduli of elasticity and the Φ's as generalized coeffs. of elasticity. A. M. R.

539.31 : 548.0

Study of internal stresses and dislocations in metals. *See Abstr.* 7385

539.313

7317. Small motions in non-ideal elastic bodies. GRASSMANN, F. *Schweiz. Bauztg*, **67**, 55–6 (*Jan.* 22, 1949) *In German.*—A linear differential operator is defined and used to generalize Hooke's law. The equations of motion in vector form are derived for the medium and used to obtain a wave equation for longitudinal and transverse waves. The form of the operators is given for some ideal bodies.

539.32

7318. Structural and elastic properties of metals. JONES, H. *Physica*, **15**, 13–22 (*April*, 1949) *In English.*—A short review of the method of calculating the energy of a structure, followed by an account of the effect of the various terms in the energy expression on the elastic properties and anisotropy of some cubic and hexagonal metals. The effect of solid solutions on structure is also considered. A. E. DE B.

539.32

7319. On the statistical theory of rubber-like elasticity. SAKAI, T. AND ISIHARA, A. *J. Phys. Soc. Japan*, **3**, 171–4 (*March–June*, 1948) *In English.*—A mathematical treatment is given leading to the following expression for the modulus of elasticity of rubber-like substances at the beginning of elonga-

tion $\varepsilon_0 = 3\rho RT\lambda_0^2/m$. The expression is obtained by taking into account the statistical distribution of the lengths of the vectors representing the chains constituting the substance. Consideration of the average entropy in the stretched state leads to the stress value. G. O. B.

539.32 : 530.12

7320. The mechanics of continuous matter in the relativity theory. CLARK, G. L. *Proc. Roy. Soc. Edinb. A*, **62** (*Pt IV*) 434–41 (1949).—The Lorentz theory of elasticity is defended, but is modified by the postulate that the velocity c_0 of propagation of dilatation $\leqslant c$; material is called *incompressible* when $c_0 = c$. The rotation of an incompressible disc is discussed in the case of small strain; it is found that relativity contraction is exactly balanced by classical expansion. R. A. N.

539.32 : 548.55

7321. Elastic constants and internal loss of single nickel crystals. BOZORTH, R. M., MASON, W. P., MCSKIMIN, H. J. AND WALKER, J. G. Letter in *Phys. Rev.*, **75**, 1954–5 (*June* 15, 1949).—Elastic constants are deduced from measurements of sound velocity by pulse technique on single crystals of Ni about 0·5 cm thick in [110] and [100] directions. There is no coupling between the single longitudinal and the two shear waves. Unusually high absorption suggests damping due to eddy currents. N. F. A.

539.371

7322. A note on the torsion of an incompressible highly-elastic cylinder. RIVLIN, R. S. *Proc. Camb. Phil. Soc.*, **45** (*Pt* 3) 485–7 (1949).—See Abstr. 3977 (1948).

539.374

7323. Experiments on plasticity. V. The behaviour of clays in the tensional experiment with particular reference to the "local elongation" or "necking." MACEY, H. H. *Trans. Brit. Ceram. Soc.*, **47**, 291 (1948).—Tensional experiments on clay bars at constant rates of extension are considered both as a whole and with particular reference to the second stage in which the clay pulls out into a "neck." Data on 10 widely different clays are reported and discussed. A parallel with the behaviour of cold-worked Cu bars under tension is found and part, at least, of the disagreement found between repeat experiments can be explained by the supposition that the clay bars have, originally, different arrangements of the particles or "structures," although made under identical conditions. In bars of the same moisture content, high max. stress values are associated with low elongations. B. R. C. B.

539.374

7324. Variational principles in the theory of finite plastic deformations. PHILLIPS, A. *Quart. Appl. Math.*, **7**, 110–14 (*April*, 1949).—The principles for the virtual displacements and the virtual stress variations are given, in the case of strain-hardening. For previous work see Abstr. 615 (1940). L. S. G.

539.374 : 541.18.025

The phenomenon of "backlash." *See Abstr.* 7367

539.378

7325. Sessile dislocations. FRANK, F. C. *Proc. Phys. Soc., Lond. A*, **62**, 202–3 (*March*, 1949).—A type of dislocation incapable of glide under any macroscopically applicable stress is described. Such a dislocation is called "sessile" in contrast with "glissile" dislocations—those which are capable of glide. H. P. M.

539.378.3

7326. Vacancies and diffusion in NiAl. SMOLUCHOWSKI, R. AND BURGESS, H. Letter in *Phys. Rev.*, **76**, 309–10 (*July* 15, 1949).—A Ni vacancy cannot diffuse, as it is too small to be occupied by an Al atom. The diffusion coeff., measured with radioactive Co, is therefore small ($\sim 10^{-11}$ cm²/sec at 1 150°c) for alloys with less than 50 at. % Ni, in spite of the large number of vacancies [Abstr. 1449 (1937)], but increases rapidly to $\sim 3 \times 10^{-10}$ for alloys with 60 at. % Ni. A. J. C. W.

539.382

7327. The theory of plane plastic strain for anisotropic metals. HILL, R. *Proc. Roy. Soc. A*, **198**, 428–37 (*Aug.* 22, 1949).—A yield criterion and plastic stress-strain relations are formulated for anisotropic metals deformed under conditions of plane strain. The equations are shown to be hyperbolic, the characteristics coinciding with the directions of max. shear strain-rate. When the anisotropy is uniformly distributed, the variation of the stresses along the characteristics is expressed in terms of elliptic functions, and geometrical properties of the field of characteristics are established. The theory is applied to the problem of indentation by a flat die. A.

539.389.3

7328. Relaxation measurements on systems having colloidal structure. VEĬLER, S. YA., LIKHTMAN, V. I. AND REBINDER, P. A. *Colloid J., USSR*, **11**, 8 (1949).—An apparatus is described in which a vane attached to a spring is suspended in the relaxing system, the relaxation being followed by observations on a scale with a cathetometer. Gelatine sols are shown to follow Schwedoff's law, i.e. there is a linear plot for $\log (P - P_\infty)$ *v. t.* B. R. C. B.

539.389.3 : 669

7329. Relaxation phenomena in metals. ZENER, C. *Physica*, **15**, 111–18 (*April*, 1949) *In English.*—A short account of the nature of mechanical relaxation in metals, referring to the different types of process giving rise to peaks in the relaxation spectrum. A. E. DE B.

539.4.016

7330. Evidence for a change in the nature of work-hardening at small strains. KOEHLER, J. S. AND BLEWITT, T. H. Letter in *Phys. Rev.*, **75**, 1952–3 (*June* 15, 1949) *In English.*—A brief review of the present state of knowledge on work-hardening leads to the formulation of several leading questions, answers to which the authors consider would be of value. G. O. B.

539.433

7331. Slow-motion pictures of impact tests by means of photoelasticity. FOEPPL, L. *J. Appl. Mech.*, **16**, 173–7 (*June*, 1949).—Details are given of two tests made in the investigation of the distribution of stresses and their variation with time for a "Dekorit" test bar subjected to impact at its centre. The

apparatus is described. In one test the impact is of moderate intensity and the results verify the classical theory of St. Venant and Flamant; in the other the bar is broken. Many photographs are shown, including those showing the actual rupture. H. G. J.

539.501

7332. Viscosity and related properties in glass. JONES, G. O. *Rep. Phys. Soc. Progr. Phys.*, **12**, 133–62 (1948–49).—The formation of glasses by a freezing-in of the liquid configuration is described with particular emphasis on the importance of flow properties for this process. A review of observations on viscosity, delayed elasticity and transformation is followed by their representation in terms of models whose molecular interpretation is discussed. The ideas surveyed have practical applications to annealing problems and thermometer creep. 8 diagrams show typical flow and transformation phenomena and about 70 references are given. R. O. D.

539.531

7333. Abrasion tests on diamonds. I. Directional properties. GRODZINSKI, P. AND STERN, W. *Nature, Lond.*, **164**, 193–4 (*July* 30, 1949).—The directional hardness of selected diamond faces is revealed by a new micro-abrasion test. In this, a diamond-dust-loaded wheel rotates at high speed under constant load and makes abrasion cuts in specific directions, the length being a measure of the hardness. Data are reported for a cube plane and a dodecahedron face. 3 good grinding directions are observed. The results are discussed in relation to traditional views on polishing and to crystallographic theory. S. T.

539.531

7334. Abrasion tests on diamonds. II. Interferometric examination. TOLANSKY, S. AND AUSTIN, E. *Nature, Lond.*, **164**, 194–5 (*July* 30, 1949).—The abrasion cuts on diamond surfaces described in Part I [preceding Abstr.] are examined by multiple beam interferometry. It is found that the polish within the abrasion is high, there is no ploughing up and the profile of the cut is shown. The cuts are much shallower than expected from the geometry of the grinding wheel. The discrepancy is attributed to elastic flattening. Evaluation of the volume of the abraded material by simple geometrical methods based only on the length of the cut is seriously in error and can only be corrected by interferometric check observations. S. T.

539.531

7335. A microhardness tester for use with an inverted microscope. TOWNEND, G. H. *J. Sci. Instrum. Phys. Ind.*, **26**, 295–6 (*Sept.*, 1949).

539.89

7336. Concerning the high pressure allotropic modification of cerium. LAWSON, A. W. AND TANG, T.-Y. *Phys. Rev.*, **76**, 301–2 (*July* 15, 1949).—X-ray diffraction patterns of the high-pressure modification of Ce were obtained by the Be bomb technique. Patterns taken at about 15 000 atm. pressure show that the high-pressure modification of the initially face-centred cubic lattice stable at atmospheric pressure is also face-centred cubic, with $a = 4{\cdot}84 \pm 0{\cdot}03$ Å, giving an overall vol. change at this pressure of 16·5%, in agreement with the results of Bridgman. An explanation of the results is proposed. The pressure appears to be sufficient to cause a $4f$ electron to pass into the $5d$ state. This is in agreement with the fact that a similar transformation does not occur with La or Pr. A metastable close-packed hexagonal form of Ce was also observed at pressures below the transformation pressure. A. J. M.

539.893

7337. Linear compressions to 30 000 kg/cm². BRIDGMAN, P. W. *Proc. Amer. Acad. Arts Sci.*, **77**, 187–234 (*April*, 1949).—Describes a modified lever piezometer applicable to measurements up to 30 000 kg/cm² on materials less compressible than Al. Measurements are reported on a large number of elements, alloys, intermetallic compounds and minerals. It is concluded that true homogeneity is rarely found, and most materials have imperfections of structure or composition which lead to hysteresis. Examination of the properties of the liquid medium at pressures up to 30 000 kg/cm² showed that there was no possibility that the specimens were subject to pressures which were not truly hydrostatic. N. F. A.

PHYSICAL CHEMISTRY 541

PHASE EQUILIBRIUM 541.121/.123

541.122.3

7338. Equilibrium in non-electrolyte mixtures. SCATCHARD, G. *Chem. Rev.*, **44**, 7–35 (*Feb.*, 1949).—A number of topics concerned with the thermodynamics of equilibria in non-electrolyte mixtures is considered. A. J. M.

541.122.3

7339. Critical phenomena in binary liquid systems. RICE, O. K. *Chem. Rev.*, **44**, 69–92 (*Feb.*, 1949).—The co-existence curve in the pressure-volume plane, for the equilibrium between liquid and vapour in a one-component system is not rounded, as required by the simple van der Waals theory, but shows a horizontal, constant pressure portion at the critical temp. The isotherm at the critical temp. has a corresponding horizontal portion. Conditions leading to a similar horizontal portion in the case of two-component liquid systems are discussed. If the curve is rounded the first and second derivatives of the chemical potentials with respect to concentration must vanish, but if it has a horizontal portion only the first derivative must vanish. The problem is also considered from the concept of associating molecules. The condition for the vanishing of interfacial tension is discussed. Experimental evidence appears to show the existence of curves with a horizontal portion, and also of curves with a rounded section at the critical temperature.

The effect on the critical temp. of the addition of a third component is considered, and suggestions are made for future experimental work. A. J. M.

541.123.2

7340. New data for Margules' relationships between partial pressures. MUSIL, A. *Acta Phys. Austriaca*, **3** (*No.* 1) 111–25 (1949) *In German.*—New data are now discussed with respect to the Margules' expressions for partial pressures and their relationship to activities and activity coeffs. of binary mixed phases. The whole is a contribution towards a general activity theory of non-electrolytes. In particular, limiting solubility formulae for the vapour pressure curves of binary liquid mixtures are established, which enable the calculation of the thermodynamic activities of the two mixture components. H. H. HO.

REACTION KINETICS 541.124/.128

541.124

7341. On the thermal reactions in gas phase. I. KANAI, E. *Progr. Theor. Phys.*, **4**, 11–24 (1949).—Theoretical. The 3 assumptions of present-day theory in reaction kinetics are examined critically, viz.: (i) adiabatic treatment of electronic motions, (ii) classical treatment of nuclear motions, (iii) thermal equilibrium between the initial and the final state of the system. Both first- and second-order reactions are considered, the former in detail. The nature of the activated complex is discussed by reference to an adaptation of the theory of nuclear reactions. S. J. G.

541.124

7342. Distribution of the kinetic energy in reacting gas systems. STUPOCHENKO, E. V. *J. Exp. Theor. Phys., USSR*, **19**, 493–501 (*June*, 1949) *In Russian.*—The kinetic energy is considered of particles which are products of a gas reaction of a stationary character. The exact solution is obtained of the integral equation of the problem for the case of equal masses and an ideal potential barrier as an approximation to the law of interaction; this solution is valid for any value of the energy. An approximate expression is also obtained for the distribution function in the range of high energy values. The paper deals in particular with the distribution of the kinetic energy of the product molecules. A numerical example is given. B. F. K.

541.126

7343. On the calculation of the velocity of deflagration of gaseous mixtures contained in closed vessels. MANSON, N., GUÉNOCHE, H. AND SALÉ, B. *C.R. Acad. Sci., Paris*, **228**, 1637–9 (*May* 23, 1949) *In French.*—The calculations are based on a theory of combustion-zone structure developed by Manson [see Abstr. 3935 (1949)]. For 3 mixtures of hydrocarbons with O_2 and N_2 and for CO with wet O_2, at an initial pressure of 1 atm. and final pressures up to 3 atm., the calculated velocities agree with observation to better than 27%. Agreement is not so good for the CO mixture at sub-atmospheric pressures; this is attributed to the appreciable thickening of the combustion zone at low initial pressures. A. SCH.

541.126

7344. The formation of explosive vapour/air mixtures with blends of hydrocarbons and their true flashpoints. MÜLLER-HILLEBRAND, D. *Ark. Kemi. Min. Geol. A*, **26** (*No.* 18) 1–21 (1948) *In English.*

541.126

7345. The relationship between performance and constitution of pure organic explosive compounds. LOTHROP, W. C. AND HANDRICK, G. R. *Chem. Rev.*, **44**, 419–45 (*June*, 1949).

541.126

7346. Initiation of solid explosives by impact and friction: the influence of grit. BOWDEN, F. P. AND GURTON, O. A. *Proc. Roy. Soc. A*, **198**, 337–49 (*Aug.* 22, 1949).—An experimental study of the initiation of solid explosives, and in particular the effect of artificially introducing transient hot spots of known maximum temp. This was done by adding small foreign particles (or grit) of known m.p. The min. transient hot-spot temp. for the initiation of a number of secondary and primary explosives has been determined in this way. It is shown that the m.p. of the grit is the determining factor, and all the grits which sensitize these explosives to initiation either by friction or impact have m.p.s above a threshold value which lies between 400 and 550°C. Grit particles of lower m.p. do not sensitize the explosives. The same explosives initiated by the adiabatic compression of air required, for initiation, min. transient temps. of the same order as the threshold m.p. values. The results provide strong evidence that the initiation of solids as well as of liquids by friction and impact is thermal in origin and is due to the formation of localized hot spots. There is evidence that in the case of the majority of secondary explosives which melt at comparatively low temps., intergranular friction is not able to cause explosion and the hot spots must be formed in some other way. With the primary explosives which explode at temps. below their m.p., hot spots formed by intergranular friction can be important. A.

541.126

7347. Birth and growth of explosion in liquids and solids initiated by impact and friction. BOWDEN, F. P. AND GURTON, O. A. *Proc. Roy. Soc. A*, **198**, 350–72 (*Aug.* 22, 1949).—The birth and growth of explosions initiated by mechanical and thermal means have been studied. Liquid and solid explosives show a striking similarity. The point of initiation is always located at a source of local high temp., for example, a hot wire, an electric spark, an impacted grit particle, or at a gas pocket suddenly compressed during impact. There is an appreciable time lag between the first moment of impact and the first appearance of light from the explosion. With secondary explosives the time lag depends on the conditions of impact (it could be varied from 60 to 150 μsec), but for all the explosives studied the delays under similar conditions are approximately the same. For the primary explosives the time lags are usually much shorter, indicating that a different mechanism of initiation may be operative. The first stage of explosion in liquids is a burning which begins slowly and accelerates to speeds of 500 or even 1 000 m/sec. This speed may represent, in the main, a mass move-

ment of the gas products away from the centre of explosion. In most solid explosives (both primary and secondary) the first stage is again a slow burning which accelerates to speeds of several hundred m/sec. A second stage of constant velocity detonation then sets in. The detonation velocity (which varies from 1 100 to 2 300 m/sec according to the explosive and the physical conditions of the layer) may be identified with the low-velocity detonation in large charges, and the correct order of velocity has been explained on hydrodynamic grounds. It is suggested that the continued propagation of the low-velocity detonation stage in a liquid is made possible by the rapid breaking up of the explosive by the detonation shock front, particularly if the liquid has a low viscosity. In more viscous liquids and solids propagation is possible only if hot-spot sources are present in the explosive. The hot spots may be developed by rapid compression of gas pockets, or, if the solid has a high enough m.p., by intercrystalline friction. A.

541.126

7348. Influence of entrapped gas on initiation of explosion in liquids and solids. YOFFE, A. *Proc. Roy. Soc. A*, **198**, 373–88 (*Aug.* 22, 1949).—Further evidence has been obtained for the view that the initiation of explosion by impact in liquids is due to the compression and adiabatic heating of trapped gas. It is shown that the sensitivity of an explosive is very dependent upon the pressure ratio. Flat impact experiments on nitroglycerine spread as a ring on a flat anvil show that the explosion efficiency, which is high when the initial gas pressure is 1 atm., is reduced to zero when the initial gas pressure ~ 30 atm. A high explosion efficiency is still observed when the initial air pressure is $< 10^{-5}$ mm, and it is suggested that under these conditions the initiation is due to the compression of the nitroglycerine vapour itself present at a pressure of $\sim 10^{-3}$ mm. It is further suggested that the explosion begins in the vapour phase. The behaviour of some solid secondary explosives such as P.E.T.N. and cyclonite shows many similarities to that of the liquid explosives. When spread as a ring rather than as a uniform film of crystals, an increase in explosion efficiency is again observed. When the impacts are carried out at an initial gas pressure of 100 atm. there is a considerable reduction in explosion efficiency. The striker must be sufficiently hard to make the explosive flow plastically so that gas pockets can be sealed off. Again it would appear that the adiabatic compression of trapped gas initiates the explosion. Even when spread as a continuous film of crystals, the air spaces which are present between the crystals may be sealed off by local melting or plastic flow during the impact and the adiabatic compression of these gas spaces may initiate the explosion. A.

541.126

7349. The ignition of solid explosive media by hot wires. JONES, E. *Proc. Phys. Soc. A*, **198**, 523–39 (*Sept.* 7, 1949).—An investigation of the physical factors affecting the ignition of solid explosives by heated filaments embedded in the medium. The filaments were composed of fine resistance wire and were heated electrically, the critical thermal energy required to cause ignition being measured for wires of different geometrical, thermal and electrical characteristics and for different times of heating. Systematic variation of these factors enabled the energy equation for the ignition process to be formulated and its terms, analysed, the technique involving extrapolation to zero time of heating as a means of eliminating heat losses from the ignition system, and extrapolation to zero diameter of wire in order to eliminate terms involving the heating element; the former simulates the ideal case of a heat-insulated ignition system and the latter that of a line source of heat. The energy equation for ignition in these circumstances takes a simple form which implies that, at the moment of ignition, the heat supplied to the ignition system always equals the heat gained by the system plus the heat lost, the absence of any term representing heat generated by chemical action being very significant. For a given ignition system, the amount of heat absorbed up to the moment of ignition is shown to be independent of time, so that the increase in ignition energy with increasing time of ignition is wholly attributable to the heat losses sustained by the ignition system during the heating process. Further analysis shows that the critical factor governing ignition in systems of the type considered is the temp., and that the geometry of the heating element probably determines the amount of explosive which must be raised to the critical temp. to ensure ignition. A.

541.126 : 534.222.2

7350. Ignition of explosive gas mixtures in shock waves. ZELDOVICH, YA. B. AND SHLYAPINTOKH, I. YA. *Dokl. Akad. Nauk, SSSR*, **65** (*No.* 6) 871–4 (1949) *In Russian.*

541.127

7351. [Contribution] to the theory of the formation of oxide film on alloys. ORLOV, A. N. AND SMIRNOV, A. A. *J. Tech. Phys., USSR*, **19**, 550–7 (*May*, 1949) *In Russian.*—Further development of the theory of high-temp. oxidation of binary alloys [see Smirnov, A. A., *J. Exp. Theor. Phys.*, **14**, 46 (1944)]. A solution of the problem is given for the case when the diffusion coeffs. of both metals in the oxide depend on the composition of the latter. The influence of temp. on the speed of oxidization is considered in more detail. F. L.

541.127 : 539.167.3

7352. The validity of the use of tracers to follow chemical reactions. BIGELEISEN, J. *Science*, **110**, 14–16 (*July* 1, 1949).—Theoretical. The specific activity of the products of isotopic reaction are calculated by integration of the rate equations neglecting changes in specific activity due to radioactive or nuclear processes for which allowance can be made by the use of the equations of radioactive transformation. W. R. A.

ELECTROCHEMISTRY 541.13

541.132

7353. The variation of the properties of electrolytic solutions with degrees of dissociation. YOUNG, T. F. AND BLATZ, L. A. *Chem. Rev.*, **44**, 93–115 (*Feb.*,

1949).—Methods of determining the degrees of dissociation of electrolytes, including conductance methods, the investigation of light absorption and Raman spectra, are reviewed. The application of light absorption and Raman spectral methods to the study of the composition of conc. solutions of HNO_3 is summarized. The Debye–Hückel theory, conductance data, kinetic measurements, and the intensities of Raman lines give a reasonably consistent picture of the mol. constitution of aqueous solutions of H_2SO_4 of all concentrations. Reasonably satisfactory theoretical curves for the heat of dilution, apparent molal vol., and surface tension of solutions of H_2SO_4 at different concentrations can be arrived at from available data, but experimental values are too uncertain for an entirely satisfactory comparison with calculated values of heat capacities. A. J. M.

541.133.08

7354. High frequency conductivity bridge using cells with external electrodes. VERGNOLE, J. *C.R. Acad. Sci., Paris*, **228**, 1434–5 (*May*, 1949) *In French.*—A method for measuring the conductivity of solutions using a cell with external Al electrodes is described with a diagram of the electronic circuit. A modulated h.f. current is fed to two conductivity cells in parallel, one containing a control solution. A double probe transmits the low frequency voltage across each cell to the grids of a double triode charged cathodically. The cathodic currents, which are $\propto$ the respective conductivities of the solutions in the cells, are balanced on a potentiometer using a magic eye. J. O'M. B.

541.133.08 : 621.317.331

7355. Note on a conductivity cell usable with viscous liquids, pastes, suspensions, and wetted solids. OTTO, E. Note in *Rev. Sci. Instrum.*, **19**, 368 (*May*, 1948).—The new cell, developed in research on gelatinous pastes for dry cells, can be used for all stages from free-flowing liquids to wetted solids. Primarily designed for highly conductive dispersions, it would probably be also suitable for medium conductivities, as cell resistances of 85 000 Ω have been measured.

541.134.4

7356. Variation of the electromotive force of the gas cell with pressure. Electromotive force of the oxygen concentration cell. KARPEN, V. *C.R. Acad. Sci., Paris*, **220**, 231 (*Jan.* 17, 1949) *In French.*—It is pointed out that the Nernst classical formula established for the e.m.f. of the O–H cell has never been verified by experiment, and data are now submitted for the variation of e.m.f. with pressure in the case of the O concentration cell. H. H. HO.

541.135

7357. Studies in electrolytic polarisation. IV. The effect of the solvent on the hydrogen overpotential (ii). BOCKRIS, J. O'M. AND IGNATOWICZ, S. *Trans. Faraday Soc.*, **44**, 519–27 (*July*, 1948).—The overpotential in mixed aqueous-non-aqueous and anhydrous solutions of HCl containing methyl alcohol (Cu cathode), ethyl alcohol (Sn cathode) and dioxan (Sn cathode) was measured over a complete range of solvent compositions in the c.d. range 10^{-3} — 5×10^{-1} A/cm². In all systems examined, H overpotential tends to be lowered in the anhydrous solutions. On Sn cathodes, maxima are reached at intermediate compositions. The long time-variations of overpotential both after commencement and cessation of the polarizing current are described. The time-variation of overpotential supports the view that at least a part of the total overpotential is not concerned with the slow discharge mechanism generally described. The solvent effect is discussed according to a model of the working electrode in which the essential feature consists in the assumption that a solvent layer, held on the surface of the electrode, affects the velocity of the rate-determining combination reaction occurring at the cathode during the electrolytic evolution of H molecules. The mode of attachment of the solvent layer is postulated as being either predominantly by coulombic or van der Waals forces according to the nature of the cathode surface, and the electrical and chemical properties of the solvent molecules. The qualitative version of the theory described accounts for the main features of the results reported. [See Abstr. 5744 (1949)]. A.

541.135

7358. Relaxation oscillations of a special type. DARMOIS, E. AND DOLINSKI, S. *C.R. Acad. Sci., Paris*, **228**, 389–90 (*Jan.* 31, 1949) *In French.*—The periodic oscillations discovered in electrolytic cells by Schönbein, Hedges and others, were ascribed by Hedges to the formation of anodic layers of moderate solubility (e.g. CuCl for Cu in HCl). These oscillations are now found to be capable of suppression by attachment of the electrodes to an external vibrating system, when a certain amount of polishing is produced on the electrodes. The cell studied is that involving Ag and KCN, and a graph of the oscillations shows that the potential increases rapidly and decreases slowly, depending on the concentrations of the cell components. The changes observed are ascribed to polarization of both electrodes and of the anode in particular. H. H. HO.

541.135

7359. Note on the theory of electrolytic double layers. DEKKER, A. J. *Canad. J. Res. B*, **27**, 682–7 (*July*, 1949).—The mechanism suggested by Gurney [*Proc. Roy. Soc. A*, **134**, 137 (1931)] for the formation of a double layer at the interface of a metal and a solution containing its ions is applied to a diffuse double layer. The diffuse part of the double layer is treated in a way that differs from Stern's method, leading to a more convenient formula for the potential ψ_δ of the diffuse part. Numerical values and a comparison with Stern's results are given. A.

541.135.5

7360. The potential of Al in NaCl solutions. IV. Effect of buffering. ERGANG, R. *Nachr. Wiss. Göttingen* (*No.* 2) 93–5 (1946) *In German.*—Initially the potentials of Al electrodes in NaCl solutions with and without acetate buffer are the same, but the polarization curves are different. The variation of potential with time for cathodes and anodes in buffered and unbuffered solutions is irregular. In unbuffered solutions an alkaline reaction is found at the cathode causing deposition of an $Al(OH)_3$ film, and the effect of this on the potential is described. J. O'M. B.

541.135.5

7361. The formation of barrier anodes of aluminium at different concentrations of oxalic acid solutions. GUMINSKI, K. *Bull. Int. Acad. Polonaise Sci. Lett. A* (*Nos* 7–10) 133–41 (*July–Dec.*, 1947) *In English.*—The formation of rectifying polished Al anodes has been studied in aqueous oxalic acid solutions of *p*H 0·8, 1·5, 1·6, 1·7, 2·0, 2·3 and 3·3. At each *p*H the potentials (up to 250 V) required to maintain the direct current constant at 50, 30 or 10 mA were measured during the formation of the rectifying layer. The lower the *p*H of the solution the longer the time of formation and the thicker the layer. The course of the formation of the oxide barrier layer is influenced by *p*H and current. At the lower *p*H values and the higher currents and potential log time graphs show a characteristic inflection which largely disappears in the *p*H range 1·6–2·0. The phenomena observed are given a qualitative explanation in terms of two opposing tendencies, one the formation of a thin barrier layer, the other the dissolution of this layer by the acid. J. O'M. B.

PHOTOCHEMISTRY 541.14

541.14

7362. Study of the oxidation of potassium iodide in aqueous solution by ionizing radiations. LEFORT, M. *C.R. Acad. Sci., Paris*, **228**, 831–3 (*March* 7, 1949) *In French.*—The oxidation of aqueous KI by X-rays and α-rays has been examined as a function of concentration and *p*H. W. R. A.

541.14 : 542.952

7363. Polymerization by γ-rays. I. CHAPIRO, A. *C.R. Acad. Sci., Paris*, **228**, 1490–2 (*May* 9, 1949) *In French.*—Factors affecting the polymerization of polystyrene by γ-rays have been investigated: polymerization is a linear function of time, varies as the square root of the intensity of irradiation, proceeds by a chain mechanism, is accelerated by compounds containing the OH group and by various other compounds to a lesser extent, and is inhibited by addition of 1% of benzoquinone. W. R. A.

541.141 : 578.088.5

7364. Relationships between chemical and biological effects of ionizing radiations. ZIRKLE, R. E. *Radiology*, **52**, 846–55 (*June*, 1949).—Evidence that the intermediate mechanism between ionization and biological effect is chemical is given, and methods by which the relevant chemical reactions might be identified are discussed. These depend on using radiations of as widely differing ionizing characteristics as possible, e.g. α- and γ-rays. The part played by free water radicals in initiating chemical actions in solution [Abstr. 444 (1948)] is reviewed in detail and the implications of the free radical theory are examined. F. T. F.

541.141.5

7365. Transfer of energy between N and Hg. FINKELSTEIN, A. *C.R. Acad. Sci., Paris*, **228**, 1864–5 (*June* 13, 1949) *In French.*—The thermal decomposition of silver nitride results in the liberation of active N which returns to its stable state by emitting in the u.v. range. The intensity of the radiation increases, but the speed of the reaction is not modified, in the presence of Hg atoms. The principle of this phenomenon is a quantum theoretical one, the following scheme explaining it:

$$N_2^{**} + Hg \rightarrow N_2^{*} + Hg^{*}$$
$$N_2^{*} \rightarrow N_2 + h\nu$$
$$Hg^{*} \rightarrow Hg + h\nu$$

Thus each molecule of active N produces two photons in the u.v. This accounts for the increase in intensity. W. S.

COLLOIDS . DISPERSE SYSTEMS 541.18/.182

541.18.025

7366. Dynamic shear resistance of thixotropic systems. KOLTASHEV, N. G. *Colloid J., USSR*, **11**, 73 (1949).—Thixotropic aluminium hydroxide sols in narrow (dia. 0·3–1·3 cm) U-tubes are sucked into one arm then allowed to fall under gravity. The rate of fall and the final difference of level are claimed to give a quantitative measure of thixotropy, in view of the re-setting which proceeds during the course of the flow. B. R. C. B.

541.18.02 : 535.434 : 537.531

The shape and ordering of the colloid particles in close-packed systems. *See Abstr.* 7052

541.18.025 : 539.374

7367. Experiments on plasticity. IV. The phenomenon of "backlash." MACEY, H. H. *Trans. Brit. Ceram. Soc.*, **47**, 259 (1948).—Certain clays, under continuously repeated alternating stresses, develop a looseness of structure, or an ability to undergo large deformation at small stress. The term "backlash" is proposed by analogy for this phenomenon which only appears in those clays or bodies in which the proportion of small particles is low. The phenomenon, and experiments illustrating its effect on stress-strain diagrams under different conditions, are described and the relation between backlash and thixotropy, are discussed. Both are considered to be due to the formation of layers in the clay between which most of the shear takes place, but to lie at extreme ends of a scale in the sense that backlash occurs with clays having few small particles, i.e. in which the perfection of packing of the particles is poor, while thixotropy occurs in those clays in which the packing is good. B. R. C. B.

541.182

7368. Wall slip effects in dispersed systems. II. Method of studying the effect and preliminary experimental results. TOLSTOY, D. M. *Colloid J., USSR*, **10**, 133–47 (1948).—A parallel-plate method is described for determining the thickness of the wall layer for slip in dispersed systems of the grease type, and its advantages over other methods are discussed. 3 greases were examined between optically planar polished glass plates, and between optically planar polished steel plates, and similar ones with file marks

running parallel to each other in one pair and at right-angles in another pair. Observation is made with an optical system. A method is indicated for calculating the thickness of the wall layer, and determining the effect of wall slip and its viscosity. Curves based on results exhibit 2 breaks, related to max. adsorption at the surface of the hydrochloride and of the base, respectively. It is concluded that the tensiometer affords a more delicate means of measuring γ than do other methods. B. A.

541.182.4

7369. Spontaneous emulsification of pure xylene in an aqueous solution through mere adsorption of a detergent in the interface. KAMINSKI, A. AND MCBAIN, J. W. *Proc. Roy. Soc. A*, **198**, 447–54 (*Sept.* 7, 1949).—Spontaneous emulsification of a pure liquid can occur. This is demonstrated when liquid hydrocarbons are quietly placed upon the surface of the solution of a suitable detergent. Here special attention has been given to xylene placed upon moderately dilute solutions of dodecylamine hydrochloride. In many cases violent disruption of the pure liquid occurs, when it is quietly placed upon a soap or detergent solution. Examination shows that the emulsified droplets still consist of pure solvent stabilized by a coating of adsorbed protective colloid. The source of the required energy is the energy of adsorption, as well as solubilization of hydrocarbon in the aqueous detergent. The emulsion formed consists of spherical droplets which therefore retain a positive interfacial tension. A.

ADSORPTION 541.183

541.183

7370. Mechanism of adsorption and the Gibbs equation. GUASTALLA, J. *C.R. Acad. Sci., Paris*, **228**, 820–2 (*March* 7, 1949) *In French.*—Theoretical. A simplified form of the classical equation of Gibbs for the adsorption isotherm of a solution of a surface-active agent is derived from the following considerations: (1) The energy liberated when the hydrophobic part of a molecule escapes from the liquid surface [see Abstr. 2972 (1946)]. (2) The energy released when a molecule is freed from its neighbours. (3) The potential energy of the surface film and its relation to the surface pressure. J. I.

541.183

7371. Verification of the adsorption law of Gibbs. MIBASHAN-SHARAGA, L. *C.R. Acad. Sci., Paris*, **228**, 822–4 (*March* 7, 1949) *In French.*—An attempt has been made to verify the Gibbs adsorption equation by (1) calculating the surface excess (Γ) from the experimental adsorption isotherm, and (2) calculating a theoretical adsorption curve. The experimental data used were those obtained by Frumkin [*Z. Phys. Chem.*, **116**, 466 (1925)] for lauric acid in very dilute HCl. The agreement between the experimental results and those derived from modifications of the Gibbs equation is better in the case of method (2) than with method (1). The discrepancy in the latter $\sim 9\%$. J. I.

541.183

7372. Adsorption studies—physical adsorption of nitrogen, toluene, benzene, ethyl iodide, hydrogen sulfide, water vapor, carbon disulfide, and pentane on various porous and non-porous solids. HARRIS, B. L. AND EMMETT, P. H. *J. Phys. Coll. Chem.*, **53**, 811–25 (*June*, 1949).—Adsorption isotherms of one to six of the above vapours have been measured on each of the following adsorbents at −195°, −78° or 0°C: pyrex glass spheres, ground pyrex glass, porous glass, reduced iron synthetic ammonia catalysts, Ag. Experimental details are given. The results are interpreted by the Brunauer–Emmett–Teller (BET) [*J. Amer. Chem. Soc.*, **60**, 309 (1938)] and the Harkins–Jura (HJ) [Abstr. 1118 (1945)] equations. For the N isotherms the two methods give concordant values for the specific area S of each adsorbent. With the other adsorbates, however, variation up to two-fold in the value of S for a given adsorbent were obtained by the BET method, calculating the area per molecule from the liquid density of the adsorbate; the HJ constant k (calculated by assuming the value of S from the N-isotherm) showed a similar variation for a given adsorbate on different adsorbents, rather than the constancy required by HJ theory. S. J. G.

541.183.02

7373. The adsorption of long chain polar compounds from solution on metal surfaces. GREENHILL, E. B. *Trans. Faraday Soc.*, **45**, 625–31 (*July*, 1949).—The adsorption isotherms of long chain polar substances on metal powder have been determined. The results show that saturation of the surface, giving a unimolecular layer, occurs at very low concentrations with strongly adsorbed substances such as stearic acid, whereas alcohols and esters require much higher concentrations. Although the initial rate of adsorption from solution is very rapid, final equilibrium may not be reached for many hours. The adsorption process appears to be the same for thoroughly cleaned and reduced powders as for oxide-coated powders. With the clean powders, however, the amount of adsorption is increased in some cases owing to an increase in the surface area brought about by the reduction and degassing procedure at 200°–250°C. A comparison is made of the adsorption results and the boundary lubricating properties of acids, alcohols and esters. There is some discrepancy in the behaviour of the alcohol, since it is more readily adsorbed on metal powders than the ester, whereas it appears to possess poorer lubricating properties. With the fatty acid and ester, however, there is close agreement between the frictional behaviour and the adsorption measurements. The fatty acid, which is more readily adsorbed (and which may react to form the metal soap) is a more effective boundary lubricant than the ester. A.

541.183.02 : 532.64

Effect of a thin adsorbed film on the energy of adhesion between solid and liquid. *See Abstr.* 6801

541.183.575

7374. An isopiestic investigation of charcoal activation. BARNARTT, S. AND FERGUSON, J. B. *Canad. J. Res. A*, **27**, 101–15 (*Feb.*, 1949).—The isopiestic method has been applied to the sorption of CCl_4,

H_2O, CH_3OH and toluene by a series of charcoals representing the same coconut shell material at different stages of steam activation. In addition, the sorption of H_2O by two charcoals impregnated with benzoic acid was studied. The isopiestic data suggest that the activation process creates surfaces active to all 4 vapours. At any stage of activation these surfaces take up proportional quantities (not equal volumes) of each sorbate at saturation pressure. At a certain stage of activation the production of surfaces active at relatively low pressures declines, indicating that new pores are being created more slowly compared with the widening of existing ones. The sorption data for H_2O do not fit in with the capillary condensation theory. [*See* Abstr. 3540 (1949)]. J. I.

ATOMIC THEORY 541.2

541.23

7375. Discrepancies between physically and chemically determined atomic weights for the elements between silver[47] and iodine[53]. WHITE, J. R. AND BUCK, J. H. Letter in *Phys. Rev.*, **75**, 1619–20 (*May* 15, 1949).—It is pointed out that physically determined atomic weights are all > the chemical values in this region. This could be due to a second sharp min. in the packing fraction curve, but is considered unlikely. The coincidence is noted between this region and that of the min. in the U^{235} fission yield curve. B. R.

CHEMICAL STRUCTURE 541.4/.6

541.57

7376. Approximate calculation of bond energies and orders by the method of spin states. VROELANT, C. *C.R. Acad. Sci., Paris*, **228**, 1029–31 (*March* 21, 1949) *In French.*—The system of equations given by a consideration of spin states is solved by a series of approximation stages, and thereby expressions for the energy and bond order within a molecule obtained. It is also shown that resonance which occurs during the juxtaposition of two molecules may be determined. H. H. HO.

541.57

7377. Characteristic frequency and chemical reactivity. ANANTAKRISHNAN, S. V. *Proc. Indian Acad. Sci. A*, **30**, 23–9 (*July*, 1949).—A linear relationship is observed between the square of the bond frequency and the activation energy in the case of a few reactions in which substituents in the para-position are changed. Earlier work on similar problems is discussed and some discrepancies accounted for. A.

541.64

7378. Further developments in the vistex method for the determination of the intrinsic viscosity of high polymers. HENDERSON, D. A. AND LEGGE, N. R. *Canad. J. Res. B*, **27**, 666–81 (*July*, 1949).

541.65

7379. Electronic structure and colour of conjugated hydrocarbons containing a triple bond. BERTHIER, G. AND PULLMAN, B. *C.R. Acad. Sci., Paris*, **228**, 397–9 (*Jan.* 31, 1949) *In French.*—The result of combining a triple bond, C≡C, with a conjugated system of double bonds, —C=C—C=C—, is studied by a comparison of the electronic structures of the phenyl derivatives of ethylene and acetylene. From the molecular diagrams for styrolene, stilbene, phenyl acetylene and tolane it follows: (1) that the delocalization of the electrons of a triple bond is < that of the same electrons of a double bond. This result is in accord with ionization potential measurements; (2) resonance of a triple bond with the benzene nucleus is < that of a double bond; (3) the lower excitation energy of the double bond system explains its stronger bathochromic effect, i.e. ethylene compounds have a deeper colour than acetylene compounds. H. H. HO.

CHEMICAL PROCESSES 542.9

542.952 : 541.14

Polymerization by γ-rays. *See Abstr.* 7363

542.952.6

7380. Studies in polymerization. V. The polymerization of vinyl acetate. DIXON-LEWIS, G. *Proc. Roy. Soc. A*, **198**, 510–22 (*Sept.* 7, 1949).—The velocity constants of propagation, transfer and termination in the polymerization of vinyl acetate at −15° and 0°c have been determined by the viscosity method. A comparison of the results with those of other authors has shown that the values for the propagation and termination constants given are probably correct to within a factor of 2. The quantum yield of the initiating reaction has been determined, and was found to be quite small, about 0·04. A.

CHEMICAL ANALYSIS 543/545

545.82

7381. Luminescence analysis. KONSTANTINOVA-SHLEZINGER, M. A. *Izv. Akad. Nauk, SSSR, Ser. Fiz.*, **13** (*No.* 2) 237–41 (1949) *In Russian.*—A review of work published during the previous 3½ years. Applications of fluorescence analysis in various fields, including engineering, and forensic, biological and pharmaceutical chemistry are briefly outlined. 27 references (15 Russian). V. B.

545.824

7382. Dosimetry by differential absorption of X-rays by means of a curved crystal spectrometer and a Geiger counter. CAUCHOIS, Y. AND TAGGART, K. M. *C.R. Acad. Sci., Paris*, **228**, 1003–5 (*March* 21, 1949) *In French.*—The detection and determination of small quantities of mixed elements in minerals is difficult by chemical methods, if these elements have similar chemical properties, such as e.g. Hf and Zr. A new

technique is suggested for quantitative measurements by means of X-ray absorption using a curved crystal spectrograph and a Geiger counter. The determination is carried out by measuring the ratio of the intensities of two separate X-ray beams of different wavelengths transmitted by the specimen and selected within the absorption discontinuities of the elements to be detected. Modifications of the method in regard to the choice of wavelengths within the continuous spectrum are indicated. R. H. H.

CRYSTALLOGRAPHY 548

548.0 : 535.543

7383. On the optical examination of transparent crystals. SCHUMANN, H. *Z. angew. Phys.*, **1**, 343–6 (*May*, 1949) *In German.*—A method is given for determining the primary optic axes in biaxial crystals using a polariscope. The method can be used on very small grains, and the 3 principal refractive indices are also determined. Results for neodymium sulphate are given by way of example. M. R. H.

548.0 : 538.222

7384. Paramagnetic resonance absorption in crystals colored by irradiation. HUTCHISON, C. A., JR. Letter in *Phys. Rev.*, **75**, 1769–70 (*June* 1, 1949).—Paramagnetic resonance is observed at 9 350 Mc/s in single crystals of LiF irradiated in a flux of about 10^{12} neutrons per cm² for periods varying from 1 to 24 hours. The width at ½ max. absorption (3 345 gauss) $\simeq$ 160 gauss and the absorption is asymmetric about the max. Neutron irradiation produces a coloration of the LiF crystals which may be removed by heating at 500°C. Paramagnetic resonance absorption then disappears completely. The observed resonance is consistent with prevalent theories of the trapping of electrons in negative ion vacancies to produce *F* centres. A similar effect is observed in KCl, although it is less intense. J. T.

548.0 : 539.31

7385. Study of internal stresses and dislocations in metals from the behaviour of silver chloride. NYE, J.-F. *Rev. Métall.*, **46**, 371–6 (*June*, 1949) *In French.*—Polycrystalline lamellae of AgCl examined under a polarizing microscope reveal by photoelastic phenomena stress distributions analogous to those expected in a metal. Residual curvature of glide planes is observed and is attributed to an accumulation of dislocations of positive sign. N. F. A.

548.1 : 548.7

7386. Crystallographic symmetry in reciprocal space. BUERGER, M. J. *Proc. Nat. Acad. Sci., Wash.*, **35**, 198–201 (*April*, 1949).—If a crystal has a symmetry element with a translational component (e.g. *q*-fold screw axis $\parallel c$) passing through a chosen origin, its reciprocal-space representation has the symmetry element without the translation component (e.g. *q*-fold axis) at the origin, the phases of the structure amplitudes connected by the element being simply related (e.g. by $\exp\{2\pi i\, pl/q\}$, where $p = 1, 2, \ldots, q$). If the symmetry element is displaced by $xa + yb$, the phases are increased by $\exp\{2\pi i(xh + yk)\}$. The position and absolute-magnitude symmetry of the reciprocal-space are those of the point group isomorphous with the space group. These theorems make it possible to write down, without tedious calculation, all the relations between *F*'s for a given space group for any chosen origin. A. J. C. W.

548.1 : 548.7

7387. The complete and unambiguous designation of space groups by tables of characters. I. NIGGLI, P. *Acta Cryst.*, **2**, 263–70 (*Oct.*, 1949) *In German.*—Space groups can be given a novel representation by means of tables of characters having the form of square matrices. These tables constitute the simplest formulation of all essential properties of the space groups (e.g. elements of symmetry, point symmetry, the general and special position of equivalent points, the structure factor for the general position, the laws of missing spectra, the lattice complexes, the laws of transformation, etc.). They offer a substitute for the descriptive part of the theory of groups and crystal structures, and play in crystal physics a role similar to that of the tables of characters used in molecular spectroscopy. The derivation and explanation of these tables is exemplified by a discussion of the space groups isomorphous with C_1, C_i, C_2, C_s, C_{2h}, D_2, C_{2v}, D_{2h} possessing simply primitive translation groups. A.

548.1 : 51

7388. General transformation formulae in geometric crystallography. DE JONG, W. F. *Acta Cryst.*, **2**, 322–5 (*Oct.*, 1949) *In English.*—For two settings of a crystal, given four sets of corresponding indices, the compatible transformation equations are derived. The four sets may be face indices, edge indices or a mixed group of four sets. A.

548.3

7389. Transformation of gnomograms and its application to the microchemical identification of crystals. I. DIJKSTRA, D. W. *Proc. K. Ned. Akad. Wet.*, **52** (*No.* 4) 441–9 (1949) *In English.*—Graphical methods are given for (1) change of the plane of projection, the axes and parametral plane being unchanged, and (2) change of axes and parametral plane. A. J. C. W.

548.3

7390. Transformation of gnomograms and its application to the microchemical identification of crystals. II. DIJKSTRA, D. W. *Proc. K. Ned. Akad. Wet.*, **52** (*No.* 5) 563–8 (1949) *In English.*—The method previously described [Abstr. 7389 (1949)] is applied to the construction of a model sugar crystal, and to determining the apparent interedge angles of a silver dichromate crystal lying on a microscope slide. A. J. C. W.

548.3 : 537.226.2

7391. Morphological and dielectric studies of some crystals of the Rochelle salt type. THORP, J. H. AND

BUCKLEY, H. E. *Acta Cryst.*, **2**, 333–7 (*Oct.*, 1949) *In English.*—Observations have been made on the morphology of crystals of the Rochelle salt type, with particular reference to the effects of added impurities. Certain noteworthy changes of habit have been recorded. Measurements have also been made on the inductivities of about 90 specimens of these crystals, at room temp., throughout the range of frequency from 650 to 2 650 kc/s. While individual values were found not to vary at these frequencies, the inductivities showed a marked dependence on composition and on the presence of cupric ions, boric acid, or the ammonium radical. A.

548.36

7392. On the crystal chemistry of cassiterite [Zinnstein]. NEUHAUS, A. AND NOLL, W. *Naturwiss.*, **36** (*No.* 1) 26–7 (1949) *In German.*—Hot extraction with dilute HCl of coloured cassiterites reduced by H at 700°c divides them into 3 groups: (i) those leaving a residue with the rutile structure (lattice parameters given), (ii) those leaving a residue of W, and (iii) those leaving no residue. The colour of the 1st group is attributed to finely divided inclusions of the mossite-tapiolite-ilmenorutile-struverite series, of the 2nd group to wolframite, and of the 3rd to iron oxides or $FeTiO_3$. A. J. C. W.

548.5

7393. Misfitting monolayers. VAN DER MERWE, J. H. AND FRANK, F. C. Letter in *Proc. Phys. Soc., Lond. A*, **62**, 315–16 (*May*, 1949).—Expressions are given for critical amounts of natural misfit of monolayers on crystalline substrates, above which abrupt increases in dislocation density occur. An application of the theory to oriented overgrowth on crystalline substrates is discussed. J. A. F.

548.5

7394. Producing diamond in the laboratory. MELLOR, D. P. *Research, Lond.*, **2** (*No.* 7) 314–17 (*July*, 1949).—A non-specialist review of the work to date, including the recent positive X-ray tests by Bannister and Lonsdale upon Hannay's artificial diamonds. Suggestions are made for modifications in Hannay's method which might yield interesting results. F. E. H.

548.523

7395. Improved crystallization of lithium fluoride of optical quality. STOCKBARGER, D. C. *Disc. Faraday Soc.* (*No.* 5) 299–306 (1949).

548.523

7396. The production of large artificial fluorite crystals. STOCKBARGER, D. C. *Disc. Faraday Soc.* (*No.* 5) 294–9 (1949).

548.523

7397. Apparatus for producing and transporting single crystals at low temperatures. Applications to nitric acid, its hydrates, and their X-ray diagrams. BOUTTIER, L. *C.R. Acad. Sci., Paris*, **228**, 1419–21 (*May* 2, 1949) *In French.*—The support on which the crystals are to be grown passes through an axial hole in a cylindrical block of Al into the liquid. Fluid and block are cooled by cold air evaporating from liquid air; a heating coil controls the temp. of the fluid. When a suitable crystal has grown, the support is withdrawn into the colder Al block and transferred to the camera, etc. No results are given. A. J. C. W.

548.524

7398. The growing of crystals by the methods of Kyropoulos and of Stöber. MENZIES, A. C. AND SKINNER, J. *Disc. Faraday Soc.* (*No.* 5) 306–12 (1949).

548.524

7399. Crystal size and cooling. WINKLER, H. G. F. *Nachr. Wiss. Göttingen* (*No.* 2) 99–101 (1946) *In German.*—The rate of nucleus formation, rate of crystal growth, and final crystal size were determined for nepheline ($NaAlSiO_4$) crystallizing from a synthetic melt at various (0–110°c) degrees of supercooling. Rock formation is discussed in the light of the results. A. J. C. W.

548.525

7400. Production of large artificial quartz crystals. FRANKE, I. AND DE LONGCHAMP, M. H. *C.R. Acad. Sci., Paris*, **228**, 1136–7 (*March* 28, 1949) *In French.*—The crystals are grown by hydrothermal synthesis in an autoclave containing an alkaline solution. A temp. gradient is maintained, quartz or vitreous silica being placed in the high temp. region, and a quartz seed in the low temp. region. The temps. vary between 200 and 300°c, at a pressure of 60 atmospheres. Single $3\times2\times0{\cdot}5$ cm crystals were obtained. J. A. F.

548.526

7401. Crystal growth in the solid state (recrystallization). BURGERS, W. G. *Physica*, **15**, 92–106 (*April*, 1949) *In English.*—Crystal formation on heat treatment of a polycrystalline metal is regarded as neutralization or displacement of dislocations. The growth of a crystal in a deformed matrix depends to a large extent on the mutual orientation of growing and disappearing lattice domain. Recrystallization regarded as a process of local melting is briefly discussed. J. A. F.

548.53

7402. Suggestions concerning intercrystalline junction processes during recrystallization. HOMÈS, G. A. AND MAQUESTIAU, M. *Physica*, **15**, 107–10 (*April*, 1949) *In English.*—All neighbour crystals in completely recrystallized Fe appear to be twinned. Two types of twin junction are discussed—crystals directly twinned along their junction planes, and "buffer lattices" in which a wedge-shaped crystal is twinned with two neighbours. J. A. F.

548.53

7403. Influence of the texture of the original matrix on the number of inclusions in aluminium single crystals obtained by recrystallization. BURGERS, W. G. AND DALITZ, V. C. *Proc. K. Ned. Akad. Wet.*, **52** (*No.* 6) 623–6 (1949) *In English.*—Large Al crystals grown by recrystallization in fine-grained material often contain many inclusions, being the unabsorbed grains of the original matrix in an approximately twin position with respect to the surrounding crystal. The growing crystal has only a slight tendency to absorb lattice regions in twin position. Hence the number of inclusions depends on the texture of the matrix; if the grains are largely orientated, practically inclusion-free crystals can be grown. J. A. F.

548.55

7404. An apparatus for the production of large metallic crystals by solidification at high temperatures. GOLD, L. *Rev. Sci. Instrum.*, **20**, 115–21 (*Feb.*, 1949).—The design and operation of an apparatus for growing metallic crystals according to Bridgman's technique [*Proc. Amer. Acad. Arts and Sci.*, **60**, 305 (1925)] is described. Metals and alloys in the range 1 100–1 600°c were grown *in vacuo*, temps. being measured with an optical pyrometer. The various high temp. difficulties are indicated. J. A. F.

548.55

7405. Preparation of aluminium single crystals with a definite orientation. TIEDEMA, T. J. *Acta Cryst.*, **2**, 261–2 (*Oct.*, 1949) *In English.*—A method is described for the preparation of Al single-crystal wires and plates with any desired orientation to within 1°. A.

MOLECULAR AND X-RAY CRYSTALLOGRAPHY 548.7

548.7

7406. On the discontinuity of distances, resulting from that of electronic interactions. FORRER, R. *C.R. Acad. Sci., Paris*, **228**, 988–90 (*March* 21, 1949) *In French.*—Considerations previously applied to Ga [Abstr. 3572 (1949)] are extended to Tl, hexagonal Ni, Pd. A. J. C. W.

548.7

7407. Electron terms and radiation from atoms in crystals. HELLWEGE, K. H. *Nachr. Wiss. Göttingen* (*No.* 2) 37–41 (1947) *In German.*—The removal of degeneracy by the crystalline field is discussed for the non-cubic crystal classes in the general case, and also in the special case of a purely electric crystalline field. Tables are given for the selection rules for electric-dipole, magnetic-dipole, and electric-quadrupole radiation. A. J. C. W.

548.7

7408. Electrons acting as ions in the crystal lattice and in solution. VOGT, E. *Naturwiss.*, **35** (*No.* 10) 298–307 (1948) *In German.*—The concept of ions and electrons is discussed with special reference to the molecular and band models for electrons in ionic crystals, especially the coloured alkali halides. It is shown how the magnetic properties of these crystals enable a differentiation between F- and F′-centres to be made. The phase relations in solutions of alkali and alkaline-earth metals in liquid ammonia are discussed, as are the electrical and magnetic properties. The electron volume for varying proportions of Na in NH_3 is calculated and a band model for the system is proposed. C. A. H.

548.7

7409. Interactions between thermal vibrations by the Debye approximation. HERPIN, A. *C.R. Acad. Sci., Paris*, **228**, 1207–8 (*April* 4, 1949) *In French.*—It is shown how molecular movements in crystals can be interpreted as thermal vibrations, and the energy perturbation function and conditions of resonance are calculated. The simple Debye approximation assuming the crystal isotropic and non-dispersive, leads to contradictory resonance conditions for the wave vectors and frequencies, and is modified by treating the wave vectors of all waves produced outside the first zone (spherical) as though they were inside it. This treatment, while mathematically unjustifiable, is claimed to agree with the physical principles of the problem and should give results in agreement with experience. C. A. H.

548.7 : 530.145

7410. On the quantum-mechanical treatment of the optics of crystals lattices. HUANG, K. *Proc. Camb. Phil. Soc.*, **45** (*Pt* 3) 452–62 (1949).—Born's theory of ionic crystals is extended, so that the motion of the lattice particles is treated by quantum mechanics. It is shown that, as in the classical theory, the local induced current at each lattice point is in phase with the local field, and that the magnitude of the induced current at each lattice point is identical with the classical value. It then follows that the rest of the classical treatment is still valid, and the results also, for the quantum mechanical treatment modification. G. J. K.

548.7 : 535.34

7411. The question of interaction between electronic transitions and crystal lattice. Absorption measurements on crystalline $Nd_2Zn_3(NO_3)_{12}.24H_2O$. MEYER, D. *Ann. Phys., Lpz.* (*Folge* 6) **2** (*Nos* 7–8) 330–44 (1948) *In German.*—The spectral absorption of light by crystalline $Nd_2Zn_3(NO_3)_{12} . 24H_2O$ has been measured in the groups of lines D, D′ and E. The crystals were grown from solution and fashioned into thin plates by a process of polishing and filing; the optical arrangements included a 6 m concave grating; measurements were made at 62·5, 80 and 140°K. In absorption, some 80% of the transitions involve a change in the vibrational states of the crystal lattice, even for the well-shielded 4*f* orbits of the Nd^{+++} ion. The total absorption of the groups D and D′ increases with the root of the absolute temp.; this is explained by an increase in transition probability. Lines corresponding to purely electronic transitions and those involving lattice vibrations are equally affected; the probability for the excitation of internal vibrations of the NO_3 ion by absorption of light in the 4*f* shell of the Nd^{+++} ion are not affected by temp. With increasing temp. the lines move towards longer wavelengths and the ½ width increases; the line profile can be described as originating from a damped oscillator. W. F. B.

548.73

7412. Thermal scattering of X-rays by a close-packed hexagonal lattice. POPE, N. K. *Acta Cryst.*, **2**, 325–33 (*Oct.*, 1949) *In English.*—The dynamical properties of a crystal for small vibrations can be described by the set of coeffs. of the potential energy forming the dynamical matrix. The elastic constants and many other observable quantities can be calculated in terms of the elements of the dynamical matrix, but, in general, the reverse does not hold. On the assumptions that only central forces need to be considered, and that only next-neighbour atoms act on one another, the dynamical matrix for a close-packed hexagonal lattice is expressed in terms of one atomic constant, which can be determined by comparing the expressions for the elastic constants with experi-

ment. The Fourier transform of the dynamical matrix and its reciprocal, which in first approximation is ∝ the scattering matrix, are then calculated. A diagram of the equidiffusion lines, which covers a part of reciprocal space containing 16 lattice points, is drawn. The diagram shows that the "extra spots" are surrounded by a weak background which exhibits considerable fine structure. The equidiffusion lines constructed for the vicinity of the selective reflections (Jahn case) agree with those calculated by Begbie for beryl. No trace is found of the intense star pattern observed by Lonsdale for ice and ammonium fluoride. A.

548.733

7413. Method of preparing capillary tube samples for X-ray diffraction powder analysis. HAGELSTON, P. J. AND DUNN, H. W. *Rev. Sci. Instrum.*, **20**, 373–4 (*May*, 1949).—Describes (i) a filling jig consisting of an amended 10/30 pyrex ground joint whose male member is closed at the tubular end, the capillary tube being fixed to the female member, and (ii) an assembly jig for attaching the capillary to the pyrex joint. R. B. S.

548.734

7414. Phase determination in direct Fourier-synthesis of crystal structures. BIJVOET, J. M. *Proc. K. Ned. Akad. Wet.*, **52** (*No.* 4) 313–14 (1949) *In English.* —The method of isomorphous replacement applied to centrosymmetric structures determines the phase of an X-ray reflection; in non-centrosymmetric structures there is still an ambiguity of sign. It is possible in theory to remove this ambiguity by making use of the abnormal phase shift introduced when the wavelength of the X-rays is near an absorption edge of the heavy atom. A practical trial is in progress. A. J. C. W.

548.734

7415. An alternative interpretation for vector maps. PATTERSON, A. L. *Acta Cryst.*, **2**, 339–40 (*Oct.*, 1949) *In English.*—The usual vector map given by $\Sigma_h F_h F_h^* \exp\{-2\pi i \Sigma_i h_i u_i\} = \int f(x_i) f(u_i + x_i) dx_i$ shows peaks of weight $2ZZ'$ whenever the vector u_i is equal to $X_i - X_i'$, the difference between two atomic-position vectors X_i. The companion map given by $\Sigma_h F^2 \exp\{-2\pi i \Sigma_i h_i u_i\} = \int f(x_i) f(u_i - x_i) dx_i$ shows peaks (*a*) of weight Z^2 where $u_i = 2X_i$, and (*b*) of weight $2ZZ'$ where $u_i = X_i + X_i'$. If a group of atoms is related by a centre of symmetry, their mutual (*b*)-type peaks will coincide. There will thus be peaks corresponding, e.g. to the centre of a benzene ring (and large peaks at actual centres of symmetry). For non-centrosymmetric structures the second map cannot be constructed until the structure is known, but for centrosymmetric structures the two maps are identical, and the second interpretation may be useful. A. J. C. W.

548.734

7416. A stereographic projector. DE BARR, A. E. *Proc. Phys. Soc., Lond. A*, **62**, 559–61 (*Sept.*, 1949).—An optical device is described by which the effect of rotation on the stereographic projection of a crystal can be observed directly. The application of the device to the construction of pole figures from X-ray data is described. A.

548.734

7417. The probability distribution of X-ray intensities. WILSON, A. J. C. *Acta Cryst.*, **2**, 318–21 (*Oct.*, 1949).—In a crystal without symmetry elements and containing a sufficiently large number of atoms the probability of the *hkl* reflection having an intensity between I and $I + dI$ is $P(I)dI$, where $P(I) = \Sigma^{-1} \exp\{-I/\Sigma\}$, and Σ is the sum of the squares of the scattering factors of the atoms. In a centrosymmetric crystal the probability of the structure amplitude of the *hkl* reflection lying between F and $F + dF$ is $P(F)dF$, where

$$P(F) = (2\pi\Sigma)^{-\frac{1}{2}} \exp\{-F^2/2\Sigma\},$$

a result noticed empirically. In a centred crystal $(k-1)/k$ of the reflections are zero, and the remaining $1/k$ of them are distributed like those of an uncentred crystal with parameter $k\Sigma$, where k is 4 for face-centring and 2 for end- or body-centring. Other symmetry elements do not produce important effects on the general reflections, but may make a zone or line of intensities behave as if centred or centrosymmetric. The mean value of I is Σ, a fact that can be used to put relative intensities on an absolute basis. The mean values of $|F|$ or I^2 can also be used, but the mean value of I is the only one independent of the symmetry. The difference between the ratios of $\langle|F|\rangle^2$ to $\langle I\rangle$ for centrosymmetric and non-centrosymmetric crystals may serve for the purely X-ray determination of a centre of symmetry. A.

548.734.3

7418. The precision determination of lattice constants by the powder and rotating crystal methods and applications. STRAUMANIS, M. E. *J. Appl. Phys.*, **20**, 726–34 (*Aug.*, 1949).—A method that makes possible the attainment of a very high degree of precision in the determination of lattice constants (in some cases more than 1 : 200 000, even with crystals of lower symmetry) is described. The method and its applications, which has been in steady development since 1934, tries to eliminate the errors of the Debye–Scherrer–Hull and rotating crystal methods by a careful experimental technique, based on: (1) Very exactly built cameras of a reasonable diameter (64 mm); (2) Elimination of all well-known errors of the powder and rotating crystal methods (e.g., elimination of film shrinkage errors by a new method of putting the film into the camera); (3) Locating the camera in a specially constructed thermostat so that the temp. some hours before and during exposure is kept constant. The films obtained in this way are very clear, especially in the important back-reflection region, with distinct lines (or spots) that can be measured exactly. As no standard substances are necessary and the absorption corrections are negligible (using very thin samples), the method must be regarded as absolute. Of course, the sample (crystal) must be prepared, mounted, and centred under the microscope, a procedure that is not difficult. Applications: lattice constants and expansion coeffs. (even within the range of 10°C); quantitative solubility determinations; appearance of new phases and transition points; the determination of the exact value of Avogadro's number; molecular and atomic weight determinations (if the exact density values are known); statement of imperfections in crystals. A.

548.734.3

7419. A method for indexing powder photographs, using linear Diophantine equations, and some tests for crystal classes. STOSICK, A. J. *Acta Cryst.*, **2**, 271–7 (*Oct.*, 1949) *In English.*—An extension in scope and directness of the Hesse [Abstr. 4035 (1948)] method for indexing powder photographs can be made by direct solution of linear Diophantine equations. For most cases of tetragonal and hexagonal crystals the extended method demands much less ingenuity than the original procedure. In addition, some tests are devised to determine the crystal class by using Diophantine relations, and by tests for linear dependence of vectors in a linear vector space. The latter method is more general than the former and gives much more information concerning the crystal class. A.

548.734.4

7420. Apparatus for producing powder-like X-ray diffraction patterns from single crystals. MATTHEWS, F. W. AND MCINTOSH, A. O. *Rev. Sci. Instrum.*, **20**, 365–6 (*May*, 1949).—The apparatus rotates the crystal about the incident beam and also about an axis perp. to it. Small angle reflections are recorded on a flat film rotated about the axis of the beam in the direction counter to the rotation of the crystal. R. B. S.

548.735.42

7421. Parallel light device for "trial and error" Fourier analysis. LOW, B. W. AND WALDRAM, J. M. *J. Sci. Instrum. Phys Ind.*, **26**, 311–12 (*Sept.*, 1949).—A device is described which may be used to obtain two mutually perp. parallel light beams. The use of this and its cruder predecessor in "trial and error" Fourier analysis is discussed. Some further applications of the device are referred to. A.

548.735.6

7422. Fundamentals of X-ray dispersion analysis of poly-crystals. KHACHKURUZOV, G. A. AND TODES, O. M. *Dokl. Akad. Nauk, SSSR*, **66** (*No.* 1) 77–9 (1949) *In Russian.*—Theoretical. A derivation of the size distribution of particles in a compact polycrystalline aggregate from the intensity distribution across a Debye–Scherrer line. Into Brekhovskikh's expression [*Jour. Exp. Tech. Phys.*, **12**, 287 (1942)] for the intensity of X-rays scattered by a monodisperse powder the author substitutes an approx. formula by Guinier [*Ann. Phys.*, **12**, 161 (1939)] which makes integration possible. With further approximations an integral equation connecting the intensity and particle size distributions for a polydisperse powder is obtained. The equation can then be solved graphically, substituting the experimental intensity data to which all instrumental corrections have been applied. The use of Geiger counters or ionization chambers for the intensity measurements is recommended. A. L. MAC.

548.735.7

7423. Study, by electrolytic polishing and X-rays, of the crystal structure of ferromagnetic ribbons. WYART, J. AND EPELBOIM, I. *C.R. Acad. Sci., Paris*, **229**, 301–3 (*July* 25, 1949) *In French.*—The lattice parameter of unannealed ribbon (Fe 17%, Ni 76%, Cu 5%, Cr 1·5%) varies from 3·5447 ± 5 Å at the surface to 3·5480 Å at the centre. The difference disappears on long annealing; it is not clear whether it is due to residual stresses or to segregation. Similar results are obtained at other compositions. A. J. C. W.

548.736.1

7424. The amorphous phase of arsenic. GEILING, S. AND RICHTER, H. *Acta Cryst.*, **2**, 305–8 (*Oct.*, 1949) *In German.*—Sublimed As and two preparations of black-brown As were found to give diffuse patterns characteristic of amorphous solids when examined by X-ray and by electron diffraction. A quantitative analysis of the intensity distribution in these patterns shows that the 3 + 3 + 6 atoms in the first 3 coordinating spheres in crystalline As are replaced by 3 + 0 + 9 atoms in the corresponding spheres of the amorphous phase. At 285°C the amorphous phase is transformed abruptly into the normal crystalline phase. Electron-microscope photographs show the amorphous phase to consist of separate spherical particles of diameter 10^{-6}–10^{-5} cm. A.

548.736.3

7425. New method of obtaining a cubic copper sulphide of the type Cu_9S_5, and structural details. HOCART, R. AND MOLÉ, R. *C.R. Acad. Sci., Paris*, **228**, 1138–9 (*March* 28, 1949) *In French.*—The composition of the salt, prepared by treating cuprous chloride at room temp. with HCl, sulphurous acid, and H_2S, was approx. $Cu_{9.5}S_5$. X-ray analysis indicated a face-centred cubic structure. J. A. F.

548.736.3

7426. On a special structure of some manganese dioxides. BRENET, J. AND HÉRAUD, A. *C.R. Acad. Sci., Paris*, **228**, 1487–8 (*May* 9, 1949) *In French.*—Manganese dioxides can be divided into 3 groups: (i) those giving the complete pyrolusite powder pattern, (ii) those giving an incomplete pyrolusite pattern, and (iii) those giving a complete or incomplete pyrolusite pattern, plus a number of more or less diffuse lines corresponding to a hexagonal cell with parameters $a = 7{\cdot}9$ Å, $c = 4{\cdot}8$ Å. The chemical activity increases with the diffuseness of the patterns. A. J. C. W.

548.736.3

7427. Crystal chemical studies of the 5*f*-series of elements. IX. The crystal structure of Th_7S_{12}. ZACHARIASEN, W. H. *Acta Cryst.*, **2**, 288–91 (*Oct.*, 1949) *In English.*—One of the phases in the Th–S system is identified as Th_7S_{12}. This compound is hexagonal with one molecule in a unit cell with dimensions $a_1 = 11{\cdot}041 \pm 0{\cdot}001$ kX, $a_3 = 3{\cdot}983 \pm 0{\cdot}001$ kX. The space group is $P6_3/m$. The complete structure is described and discussed. A.

548.736.3

7428. Crystal chemical studies of the 5*f*-series of elements. X. Sulfides and oxy-sulfides. ZACHARIASEN, W. H. *Acta Cryst.*, **2**, 291–6 (*Oct.*, 1949) *In English.*—A number of sulfides and oxy-sulfides of 5*f*-elements and of Ce have crystal structures of known types as follows: NaCl-type: CeS, ThS, US, PuS; Sb_2S_3-type: Th_2S_3, U_2S_3, Np_2S_3; $PbCl_2$-type: ThS_2; PbFCl-type: ThOS, UOS, NpOS. A.

548.736.3

7429. Crystal chemical studies of the 5*f*-series of elements. XI. The crystal structure of α-UF_5 and of β-UF_5. ZACHARIASEN, W. H. *Acta Cryst.*, **2**, 296–8

(*Oct.*, 1949) *In English.*—α-UF_5 is tetragonal body-centred with $a_1 = 6{\cdot}512 \pm 0{\cdot}001$, $a_3 = 4{\cdot}463 \pm 0{\cdot}001$ kX and two stoichiometric molecules per unit cell. In the proposed structure each U atom is bonded to 6F atoms. The UF_6 octahedra are linked by shared corners into endless strings along the a_3 axis. β-UF_5 is also tetragonal body-centred. The unit cell containing 8 stoichiometric molecules has dimensions $a_1 = 11{\cdot}450 \pm 0{\cdot}002$, $a_3 = 5{\cdot}198 \pm 0{\cdot}001$ kX. A structure is proposed in which each U atom is bonded to 7F atoms. The interatomic distances are: α-UF_5, U–6 F = 2·20 Å; β-UF_5, U–7 F = 2·23 Å. A.

548.736.3

7430. Crystal structure studies on γ-tungsten oxide. Magnéli, A. *Ark. Kemi*, **1**, *Paper* 25, 223–30 (1949) *In English.*

548.736.4

7431. The crystal structure of tetragonal potassium tungsten bronze. Magnéli, A. *Ark. Kemi*, **1**, *Paper* 24, 213–21 (1949) *In English.*

548.736.4

7432. Crystal structure studies on tetragonal sodium tungsten bronze. Magnéli, A. *Ark. Kemi.*, **1**, *Paper* 32, 269-72 (1949) *In English.*

548.736.4

7433. On polymorphic change of $BaTiO_3$. Miyake, S. and Ueda, R. *J. Phys. Soc. Japan*, **1**, 32–3 (1946) *In English.*—An investigation of $BaTiO_3$ following the independent discovery of its dielectric properties in Japan by Ogawa. X-ray powder photographs gave $a = 3{\cdot}982$ Å and $c/a = 1{\cdot}009$ as the dimensions of the tetragonal cell at room temp. c/a decreased to 1 as the temp. approached 110°c. From differential thermal analysis the transition point was determined as $112{\cdot}6 \pm 0{\cdot}5$°c. No relaxation was noted.

A. L. Mac.

548.736.4

7434. On phase transformation of $BaTiO_3$. Miyake, S. and Ueda, R. *J. Phys. Soc. Japan*, **2**, 93-7 (1947) *In English.*—A fuller account of work already described [preceding Abstr.]. The room temp. modification of $BaTiO_3$ was identified as tetragonal and its lattice constants were measured from X-ray back reflection photographs from 10 to 350°c. Intensity measurements showed that any ion displacements at the transition point ($112{\cdot}6 \pm 0{\cdot}5$°c from differential thermal analysis) were small. A specific heat anomaly was found at the transition temp. A. L. Mac.

548.736.4

7435. On transitional region in phase change of barium titanate. Miyake, S. and Ueda, R. *J. Phys. Soc. Japan*, **3**, 177–9 (*March–June*, 1948) *In English.*—Investigations previously described [preceding Abstr.] are continued in the transitional region 10°c below the Curie point. The volume of a powder sample increased steadily with temp. from 85–120°, except for the range 99–109° where it remained almost constant. The fine structure of the (510)(431) reflection was followed over the same range. On cooling, the pattern was cubic and sharp down to 110°, then became diffuse, with maximum diffuseness at 102° and grew sharper in the tetragonal modification, being quite distinct at 86°. No evidence for the coexistence of the two phases was found.

A. L. Mac.

548.736.5

7436. The crystal structure of $Th(OH)_2CrO_4H_2O$. Lundgren, G. and Sillén, L. G. *Ark. Kemi.*, **1**, *Paper* 34, 277–92 (1949).

548.736.5

7437. The crystal structure of shortite, $Ca_2Na_2(CO_3)_3$. Wickman, F. E. *Ark. Min. Geol.*, **1**, *Paper* 4, 95–101 (1949).

548.736.5

7438. On the crystal structure of Chugaev salt. Bokiĭ, G. B. and Popova, L. A. *Dokl. Akad. Nauk, SSSR*, **67** (*No.* 1) 73–6 (1949) *In Russian.*—The salt of formula $[Pt(NH_3)_5 . Cl]Cl_3 . H_2O$ crystallizes in colourless needles, optically positive, with both indices between 1·722 and 1·718. The unit cell is rhombohedral and contains 3 molecules. The space group is $R3m = C_{3v}^5$. In hexagonal co-ordinates $a = 20{\cdot}50 \pm 0{\cdot}03$ Å and $c = 6{\cdot}64 \pm 0{\cdot}03$ Å. The atomic co-ordinates (x, y, z) are: 9 Pt (0·129, –, 0), 9 Cl_I (0·243, –, 0·513), 18 Cl_{II} (0·248, 0·263, 0·488), 9 Cl_0 (0·079, –, 0·223), 9$(NH_3)_0$ (0·092, –, 0·231), 9$(NH_3)_I$ (0·172, –, 0·193), 9$(NH_3)_{II}$ (0·165, –, 0·231), 18$(NH_3)_{III}$ (0·229, 0·257, 0), 9 H_2O (0·243, –, 0·012 approx.). A. L. M.

548.736.6

7439. The modifications of calcium orthosilicate Ca_2SiO_4. Trömel, G. *Naturwiss.*, **36** (*No.* 3) 88 (1949) *In German.*—Powder photographs in a high-temperature camera show that both β- and γ-Ca_2SiO_4 transform to α' at a temp. below 1 000°c. On cooling β or a new phase β' is formed, but the addition of 15% $Ca_3(PO_4)_2$ stabilizes α' at room temp. [See Abstr. 1390 (1946)]. A. J. C. W.

548.736.6

7440. The structure and morphology of α-quartz. Saksena, B. D. and Srivastava, K. G. *Proc. Indian Acad. Sci. A*, **29**, 189–95 (*March*, 1949).—The structure is described. Energy considerations suggest that only the major rhombohedral planes will be cleavage planes, and these will be imperfect. A. J. C. W.

548.736.6

7441. The crystal structures of orthoclase and sanidinized orthoclase. Cole, W. F., Sörum, H. and Kennard, O. *Acta Cryst.*, **2**, 280–7 (*Oct.*, 1949) *In English.*

548.737

7442. The structure of Bolivian crocidolite. Whittaker, E. J. W. *Acta Cryst.*, **2**, 312–17 (*Oct.*, 1949) *In English.*

548.738.4

7443. Symmetry of kermesite. Távora, E. *An. Acad. Brasil. Ciênc.*, **22**, 75–99 (*June* 30, 1949) *In Portuguese.*—The results of morphological studies carried out by several investigators has led to the belief that kermesite (Sb_2S_2O) was monoclinic, pseudo-orthorhombic. Recent X-ray work has shown, despite the monoclinic nature of its lattice, that the mineral is actually triclinic. The paper presents the constants of the chosen reduced primitive

cell (triclinic) and the discussion of the possible non-primitive monoclinic cells. A.

548.74

7444. The crystal structure of tetrachlorocyclohexane, m.p. 174°C. HASSEL, O. AND LUND, E. W. *Acta Cryst.*, **2,** 309–11 (*Oct.*, 1949) *In English.*

548.74

7445. An extended table of atomic scattering factors. VIERVOLL, H. AND ÖGRIM, O. *Acta Cryst.*, **2,** 277–(*Oct.*, 1949) *In English.*—A table of atomic scattering factors is given for the elements H to Cu for values o $(4\pi \sin\theta)/\lambda$ up to 30. A.

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550.312

7446. The adjustment of gravity gradients. TÁRCZY-HORNOCH, A. *Geofis. Pura. Appl.*, **14,** 37–49 (*Jan.–March*, 1949) *In German.*—It is better to adjust the gravity gradients than the observations of the Eötvös balance. Corrections are discussed and a worked example given. W. A. R.

550.341 : 534.21

7447. Studies on seismic waves. I. Reflection and refraction of plane waves. FU, C. Y. *Geophysics*, **11,** 1–9 (*Jan.*, 1946).—By taking the apparent velocity along the boundary as the parameter instead of the angle of incidence, the equations for the different wave amplitudes may be put in more symmetrical forms. In this way, it is more convenient to discuss both the body waves and the Rayleigh waves at the same time. A difficulty in the plotting of the square root of the wave intensity against the angles is also discussed. When the reflection or refraction coeff. is not real, the meaning of the intensity, as obtained by squaring the absolute value of the latter quantity, needs clarification. A.

550.341 : 534.21

7448. Studies on seismic waves. II. Rayleigh waves in a superficial layer. FU, C. Y. *Geophysics*, **11,** 10–23 (*Jan.*, 1946).—Lamb's method in the theory of the plate is extended to the case in which one of the surfaces is not free. The resulting determinantal relation is similar to that of Sezawa. It is then simplified and special cases of the frequency-velocity relation are discussed. Even when the thickness of the layer is as small as a wavelength, the interaction of the upper and lower boundaries of the layer is quite slight and Rayleigh waves and Stoneley's waves may be discussed separately. A few points in connection with the application of this frequency relation to the ground roll problem are also discussed. A.

550.37

7449. On the fundamental problem of atmospheric electricity. SCHLOMKA, T. *Z. Phys.*, **125** (*Nos* 11–12) 733–8 (1949) *In German.*—A critical review is given of an earlier paper by Michel [*ibid.*, **117,** 205 (1941)] in which the maintenance of the negative charge of the earth was explained by regarding it as a homogeneously magnetized sphere rotating between a fixed conductor situated along a concentric half circle, this conductor being constituted by that part of the stratosphere which faces away from the sun. Criticizing the foregoing theory it is shown that the law of induction in a solid conductor moved across a magnetic field cannot be applied to the case of a gaseous conductor so that the basis of Michel's theory collapses. Thus the new theory is shown to produce no current flow whatsoever in the earth but to be confined to a static charge distribution in the atmosphere and inside the earth. R. H. G.

550.38 : 538.74

7450. Compasses. I. Physical basis. KUSZMANN, A. AND SCHÖN, E. *Arch. tech. Messen, Issue* 161 (*Ref.* J61–1) *T*31–46 (*May*, 1949) *In German.*—An account of the main sources of error (mis-alignment, etc.) of magnetic compasses for land, sea and air use. The magnetic deviation in Germany is changing at 0·2° per annum; there is also a variation with a 24 h period and amplitude 0·25° in winter and 0·1° in summer, together with random fluctuations of amplitude of some tenths of a degree. It is not practical to correct for the effects of acceleration in airborne magnetic compasses, and so other types are preferred. N. C.

550.38 : 550.312

7451. Derivation of magnetic and gravitational quantities by surface integration. SKEELS, D. C. AND WATSON, R. J. *Geophysics*, **14,** 133–50 (*April*, 1949).—In an earlier paper [*ibid.*, **12,** 43–56 (*Jan.*, 1947)] it was pointed out that if the vertical component of a gravitational or magnetic field is known over a horizontal plane surface of sufficient extent all other components and derivatives of the field can theoretically be calculated by surface integration of the vertical component. In this paper, examples are given to show that within certain limits such calculations are not only theoretically possible but practically so. Examples are given of the calculations of curvatures from observed gradients and of horizontal magnetic intensity from observed vertical intensity, and the calculated values are compared with those obtained by observation. Examples are also given based on artificial data, of the calculation of plumb-line deflections from gravity and of the calculation of magnetic anomalies at a given elevation above the earth from data obtained at the surface. The purpose of these calculations is to demonstrate the non-independence of the various derivatives of gravitational and magnetic potential. A.

550.8

7452. Where are uranium and thorium concentrated during mountain building? SCHWINNER, R. *Geofis. Pura Appl.*, **14,** 10–36 (*Jan.–March*, 1949) *In German.*—Vortices in the original fluid earth divide it into cells; the boundaries of which are the seat of mountain building. Ultimately, with the aid of contraction, the consolidated surface became divided into blocks by systems of folded mountains crossing each other

U and Th dissolved in the acid (and surface) fraction of the world magma became especially concentrated at the crossing of the chains. It is claimed that this theory accounts for the location of known rich U–Th deposits and enables others to be predicted. W. A. R.

550.822 : 771.31

7453. Deep-well camera. Barstow, O. E. and Bryant, C. M. *Colo. Sch. Min. Quart.*, **44**, 562–74 (*July*, 1949).—Successful photographs of the walls of a bore hole have been obtained at great depths using a strong camera chamber containing air at atmospheric pressure and housing the camera, lens, film and film drive mechanism. The rock section is illuminated by an electric lamp bulb enclosed in a bath of clear liquid between lens and rock. The apparatus is suspended on an electric cable having an exposure switch. The possibility of televising conditions at a depth and transmitting them to the surface is also discussed. A. C. C.

550.83

7454. Subsurface methods as applied in geophysics. Stommel, H. E. *Colo. Sch. Min. Quart.*, **44**, 695–769 (*July*, 1949).—A general discussion on the techniques involved in geophysical exploration, including an outline of magnetic, gravitational, seismic and electrical methods, the principles of the instruments and interpretation of results. Illustrated by field examples. A. C. C.

550.831 : 531.261

7455. A line-integral method of computing the gravimetric effects of two-dimensional masses. Hubbert, M. K. *Geophysics*, **13**, 215–25 (*April*, 1948).—It is shown that the gravity anomaly Δg at the origin of co-ordinates, produced by a two-dimensional mass of constant density contrast $\Delta\rho$, may be obtained by means of either of the line integrals $\Delta g = 2k\Delta\rho\int\theta dz = -2k\Delta\rho\int z d\theta$, where z is the vertical co-ordinate, and θ the polar co-ordinate expressed in radians of a point on the periphery of the mass in a plane normal to its axis and passing through the origin. The line integrals are evaluated around the periphery of the mass and are of opposite sign if taken in the same direction of traverse, or are of the same sign if taken in opposite directions. For use of these integrals no special equipment is required other than a simple template consisting of radial lines, θ = const., and horizontal lines, z = const. This can be constructed either for 1 : 1 or for an exaggerated vertical-to-horizontal scale. A.

550.837

7456. The fundamental equations of electrical prospecting. Maillet, R. *Geophysics*, **12**, 529–56 (*Oct.*, 1947).

550.837

7457. Theory and practice of low-frequency electromagnetic exploration. Evjen, H. M. *Geophysics*, **13**, 584–94 (*Oct.*, 1948).—Based directly on Maxwell's Field Equations, the extremely low end of the frequency spectrum may be reduced in first approximation to simple potential theory. The approximation theory is borne out by some field experiments, the results of which are presented. Agreement with the theory, however, requires that the ground have a very large effective dielectric constant. This conclusion is supported by previous observations by a number of independent observers. Thus, the relaxation time has been found to be extremely great, not only in observations directly on the ground, but also in small samples of mud, and the sign of an electric anomaly over a relative insulator, such as crystalline salt or gas and oil, invariably has been found to be negative. Both of these observations can be explained in terms of a very great dielectric constant. The value yielded by the present experimental work is of the order of 10^8. A.

550.837.7 : 538.566.2

7458. On the use of electromagnetic waves in geophysical prospecting. Horton, C. W. *Geophysics*, **11**, 505–17 (*Oct.*, 1946).—An approximate analysis of the behaviour of electromagnetic waves in a conducting medium is given. The approximations consist of replacing pairs of electrodes by dipoles and of using only the first-order images in the case of a layered earth. It is shown that under typical conditions one can measure the depth of an electrical interface 6 000 ft deep by means of electromagnetic waves. It is further shown that even a thin layer of salt water or oil-bearing sand at a depth of 6 000 ft gives an effect that is easily measurable. The response of the earth to a d.c. step function is analysed for the case in which the displacement currents are negligible. This approximation is valid for all geological formations. The shape of a commutated direct current is shown as a function of the distance of travel. A.

550.838

7459. Magnetic core orientation. Frey, M. G. *Colo. Sch. Min. Quart.*, **44**, 499–511 (*July*, 1949).—An outline of the principles involved in determining the polarity of ferromagnetic rock specimens and a discussion of the more important geological variables involved, such as the coarseness of sediment, secular variation of the earth's magnetic poles, secondary residual magnetism, rock movements, etc. A. C. C.

550.838

7460. The airborne magnetometer. Muffly, G. *Geophysics*, **11**, 321–34 (*July*, 1946).—Discusses the problem of magnetic exploration for oil from an aircraft. A new type of saturation magnetometer is described. Various orientation and stabilization schemes and their application to submarine detection and geophysical prospecting are discussed. It is shown that total-field measurement is far superior to vertical-component measurement. The newest Gulf apparatus using an automatically-stabilized continuously-recording total-field magnetometer is described. A.

550.838

7461. The Gulf airborne magnetometer. Wyckoff, R. D. *Geophysics*, **13**, 182–208 (*April*, 1948).—Airborne-magnetometer operations involve two basic problems: (1) measurement of the magnetic-field intensity; (2) navigation of the aircraft to provide the desired profile configuration and accurate mapping of the profiles flown. Currently the navigation and mapping presents the most serious problem if the operation is to be made completely airborne. A brief outline of the magnetometer instrumentation is

presented, together with a discussion of the mapping problem. Examples of results are presented. A.

550.838

7462. The direct approach to magnetic interpretation and its practical application. PETERS, L. J. *Geophysics*, **14**, 290–320 (*July*, 1949).—Discusses the solution of the inverse potential problem and its practical application in the interpretation of field data which have a scalar potential distribution. The discussion will be in terms of the interpretation of magnetic data. Among the topics discussed are: the direct calculation of basement relief, the derivation of the potential and the horizontal components of the field from the vertical intensity, the continuation of the field upward, the continuation of the field downward towards its source, the calculation of derivatives of the vertical intensity with special attention to the second and fourth, and the estimation of depths to igneous basement rocks. The uses of these tools and the information of practical value which can be obtained by their use are discussed and illustrated. Methods of rapidly making calculations using magnetic field data are given. A.

551.15

7463. On the stratification of the earth's crust according to seismic studies of a large explosion and of earthquakes. MINTROP, L. *Geophysics*, **14**, 321–36 (*July*, 1949).—The analysis of the seismograms of an explosion of 4 000 tons of munitions at Heligoland and of a great number of natural earthquakes, especially the disastrous shock at Messina (Italy) led to the discovery of a number of formations unknown heretofore down to a depth of several hundred kilometers. At depths from 110 to 118 km a plastic layer occurs which seems to represent a belt around the globe. At a depth of 183 km the melting point of a material with very high wave-velocity is reached. These findings are in accordance with the determination of the depth of Isostatic Surface by Hayford and Helmert (both in 1909) from deflections of the vertical and/or from gravity anomalies (113 and 118 km, respectively). Qualitatively, the results are also in accordance with the assumption of Gutenberg and Richter, based on the measurement of the amplitudes of the first recorded waves from numerous earthquakes with different epicentre distances and with different depths, that at a depth of 80 to 100 km the melting point of the material has been reached. A.

551.46.018 : 621.317.39

7464. An instrument for recording continuously the salinity, temperature and depth of sea water. JACOBSON, A. W. *Trans. Amer. Inst. Elect. Engrs*, **67**, *Pt I*, 714–22 (1948).—The salinity is determined from the measured electrical conductivity and temperature; depth is obtained from the measured pressure. A resistance thermometer, with a time constant of 0·45 sec, is used for measuring temperature. Conductivity is measured in a cylindrical cell having 3 coaxial electrodes, the outer and inner being joined to shield the cell from the external water. A Bourdon tube moves a contact on a slide-wire to determine the pressure. These primary elements are mounted in a heavy case with a 9-core cable for the connections. Salinity is computed according to an empirical, non-linear relation with conductivity and temperature, by means of an electro-mechanical bridge network. All the measuring and computing circuits use null methods with servo-motor operation. The results are recorded on a common chart covering 28–90°F, 20–40 parts per thousand salinity and 0–1 200 ft depth. C. F. B. (R)

ATMOSPHERE . METEOROLOGY 551.5

551.508.13

7465. A new method of sampling the upper atmosphere. SIMON, F. E. Letter in *Nature, Lond.*, **164**, 179 (*July* 30, 1949).—The collector is a vessel cooled with liquid H. The arrangement acts as a pump, and the advantage of the method over other techniques increases with falling pressure. It is pointed out that, in the practical application of the method, the vessel and its automatic valves must be capable of withstanding high pressures, and a H gas "block" in the vessel's mouth must be avoided. A first model with hand-operated valves for use in an aeroplane has been built, and a sample of 50 l at N.T.P. taken at a height of 6 km. An automatic apparatus for use in pilot balloons is being designed. S. W.

551.508.15

7466. Effect of dust and haze on measurements of atmospheric ozone made with Dobson's spectrophotometer. RAMANATHAN, K. R. AND KARANDIKAR, R. V. *Quart. J. Roy. Met. Soc.*, **75**, 257–67 (*July*, 1949).—In order to allow for the effects of scattering by haze in the determination of atmospheric O_3 by the spectrophotometer, Dobson proposed two slightly different formulae. The assumptions in these formulae are examined and Dobson's equation generalized, the particle scattering being considered to vary as λ^{-n}. Calculations show that results are more consistent if a value of n intermediate between those assumed by Dobson is adopted. In the generalized equation the term dependent on the differential dust scattering of the two wavelengths 3 300 Å and 4 450 Å changes sign throughout the year for observations made in Northern India, being positive in winter and negative in the hot season. To account for this, two explanations are offered, the first depending on the size of the scattering particles, the second suggesting that radiation from the surrounding hazy sky is added to the direct radiation from the sun. Thereafter a choice of scattering exponent for calculating daily values of ozone is considered. Several references are added. A. E. M. G.

551.509

7467. Calculation of weather changes. PRANDTL, L. *Nachr. Wiss. Göttingen* (*No.* 2) 102–5 (1946) *In German.*—A numerical procedure involving successive approximations is developed in order to determine from the density distribution for slow changes of weather, the pressure and velocity fields as well as the temporary more extensive developments. The numerical work is very considerable, but it could be

used in practical forecasting if a machine were developed to perform the numerical calculations.

R. S. R.

551.510.4

7468. Vertical distribution of atmospheric ozone in low latitudes. KARANDIKAR, R. V. AND RAMANATHAN, K. R. *Proc. Indian Acad. Sci. A*, **29**, 330–46 (*May*, 1949).—Observations of the light scattered from the clear blue zenith sky were made with Dobson's photoelectric spectrophotometer at Delhi and Poona, and these have been used to determine the height distributions of atmospheric O_3 at these places. Distributions of O_3 are given for total O_3 amounts varying from 0·155 cm to 0·217 cm at Delhi, the average heights of O_3 for these being from 26·3 km to 25·1 km. A decrease in the total O_3 amount is found to cause a rise in the centre of gravity. At Poona, distributions for O_3 amounts 0·164 cm and 0·174 cm give a more or less fixed height of 28·0 km for the centre of gravity. The paper concludes with a brief survey of the distribution of O_3 in the earth's atmosphere both in the horizontal and the vertical and shows that it is easier to understand the regional, seasonal and day-to-day variations of O_3 if one separately considers the contributions to total O_3 content over any place from the photochemical action of sunlight and from transport in the horizontal and vertical directions of the accumulated O_3 below the level of primary O_3 formation. A.

551.510.535

7469. Origin of the Mögel–Dellinger effect. SIEDENTOPF, H. *Naturwiss.*, **35** (*No.* 9) 283 (1948) *In German.*—It is suggested that the enhanced *D*-region ionization at the time of a solar eruption [Mögel–Dellinger effect] may be due to the emission of X-ray radiation of wavelength < 10 Å, probably in the region 1 to 2 Å, by the solar corona or chromosphere.

W. J. G. B.

551.510.535

7470. Ionosphere research. GROENEWOLD, H. J. *Ned. T. Natuurkde.*, **15**, 157–68 (*July*, 1949) *In Dutch.*—Summarizes research methods used, results so far obtained, and problems still awaiting solution. The effects of disturbances—Dellinger effect, ionosphere storms, eclipse of sun—are briefly described.

D. L.

551.510.535

7471. Ionospheric disturbances and terrestrial phenomena. LEITHÄUSER, G. *Funk u. Ton* (*No.* 3) 127–43 (*March*, 1949) *In German.*—Three types of ionospheric disturbances are discussed: (*a*) sudden radio fade-outs; (*b*) ionospheric storms associated with magnetic disturbances, and aurorae (*c*) disturbances, chiefly near the 100 km level, resulting from the influx of meteors. In discussing (*b*) evidence is presented for a direct connection between the occurrence of aurorae and various meteorological factors such as temp., pressure, wind direction. There is evidence, too, based on temp. measurements at Berlin, that mild winter periods have occurred in years of max. sunspot activity. The incidence of sporadic *E* ionization at the times of certain well-known meteor showers is briefly discussed. W. J. G. B.

551.510.535

7472. Lunar oscillations in the *D*-layer of the ionosphere. APPLETON, E. V. AND BEYNON, W. J. G. Letter in *Nature, Lond.*, **164**, 308 (*Aug.* 20, 1949).—An analysis of 6 years normal incidence ionospheric radio wave absorption data for Slough (England) reveals a semi-diurnal lunar oscillation of amplitude about 0·03 nepers with max. amplitude near 11.00 hours lunar time. If this absorption tide is interpreted as a vertical oscillation of the *D*-layer then the lunar tide in the height of the *D*-layer is opposite in phase to that of the *E*-layer and is of the correct phase to account for the lunar magnetic variation if the currents causing such variations flow in the *D*-layer. W. J. G. B.

551.510.535 : 621.396.11

7473. Some remarks on the ionospheric double refraction. I. Geometrical optics. BREMMER, H. *Philips Res. Rep.*, **4**, 1–19 (*Feb.*, 1949).—After a survey of the general theory, some aspects relating to short waves are worked out. An explicit form is given for Snellius' law determining the direction of propagation. The connection between this direction (called normal) and that of the corresponding ray is derived (*a*) from the mathematical theory of the characteristic surfaces of a partial differential equation, (*b*) from a consideration of Fresnel's indicial surface, (*c*) from Fermat's principle, and (*d*) from the Poynting vector. The splitting into an ordinary and an extraordinary ray at the entrance to the ionosphere, and the state of polarization when leaving the ionosphere are investigated for a given primary ray. The corresponding theory of the reflection of long waves is summarized and illustrated by a numerical example. A.

551.510.535 : 621.396.11

7474. Some remarks on the ionospheric double refraction. II. Reduction of Maxwell's equations; W.K.B. approximation. BREMMER, H. *Philips Res. Rep.*, **4**, 189–205 (*June*, 1949).—See above Abstr. Maxwell's equations for plane-wave propagation through a stratified anisotropic medium are reduced to a system of 4 ordinary first-order equations. These equations are very suitable for the derivation of W.K.B. approximations. The general theory given is worked out in detail for the special case of an isotropic medium. The computation of field strengths in the case of ionospheric reflections is discussed. A.

551.510.535 : 621.396.11

7475. Tilts in the ionosphere. ROSS, W. AND BRAMLEY, E. N. Letter in *Nature, Lond.*, **164**, 355–6 (*Aug.* 27, 1949).—Simultaneous bearing observations at two sites 10 km apart on pulse signals from a sender 700 km away show similar fluctuations of a few degrees about the true bearing. These deviations could be produced by a tilt in the reflecting *F*-layer (substantially uniform over a distance of at least 5 km) of about 4 deg. from the horizontal. W. J. G. B.

551.510.535 : 621.396.11

7476. Tidal effects in the *F* layer. JONES, M. W. AND JONES, J. G. Letter in *Phys. Rev.*, **76**, 581 (*Aug.* 15, 1949).—*F*-layer thickness measurements made at College, Alaska, show a lunar diurnal variation of

amplitude 3 km. It is suggested that the incidence of a significant lunar diurnal, rather than semi-diurnal tide, at this high latitude (65° N) can be explained by simple tidal theory. W. J. G. B.

551.513

7477. Note on a paper by G. C. McVittie. Bjørgum, O; McVittie, G. C. *Quart. J. Roy. Met. Soc.*, **75**, 324–6 (*July*, 1949).—The equations of motion of the atmosphere found by McVittie [Abstr. 3607 (1949)] contain terms involving the reciprocal of the earth's radius. Bjørgum points out that certain of these terms can be derived by considering the variation of the Coriolis parameters with latitude and others by considering the centrifugal force acting on an element of air. McVittie replies with the remark that this defeats one of the objects of his original investigation, viz. to show that all the terms arise from the single assumption that the earth is a sphere and not a plane. G. C. McV.

551.543

7478. Atmosphere oscillations. Wilkes, M. V. Letter in *Nature, Lond.*, **164**, 281 (*Aug.* 13, 1949).—In order to remove certain difficulties in the treatment by Pekeris [*Proc. Roy. Soc. A*, **158**, 650 (1937)] of long-period oscillations the author first discusses the effect of heat conductivity on the damping of atmospheric waves. He shows that the two recognized ways in which damping may arise through heat conductivity do not apply to the same physical system. Accordingly he finds that in the analysis followed by Pekeris there are no general grounds for supposing that the wave will be attenuated in the direction of energy flow. If, however, radiation is taken as the damping agency the difficulty is removed, and an analysis similar to that of Pekeris gives a wave always attenuated in the direction of propagation. A. E. M. G.

551.59 : 539.16

On the radioactivity of the atmosphere. *See Abstr.* 7215

551.593

7479. Optical methods of atmospheric sounding from the ground. Meteorological applications. Bruch, G. and Clastre, J. *C.R. Acad. Sci., Paris*, **223**, 917–18 (*Nov.* 27, 1946) *In French.*—Announces the intention of studying the movement of small undulations (known as "concamerations") seen on the edges of stars having appreciable diameters, as a means of determining atmospheric turbulence and measuring the wind. A. C. C.

551.593.1

7480. Concerning the horizontal component of atmospheric refraction. Berroth, A. *Geofis. Pura Appl.*, **14**, 1–8 (*Jan.–March*, 1949) *In German.*—For long paths, normal horizontal refraction due to the atmosphere produces deviations in the light path but experimentally observed deviations are too large. The author explains the discrepancy by a consideration of the figure of the earth. J. M. H.

551.593.9

7481. Variations of the colour of the night sky, March, 1947, to May, 1948. Grandmontagne, R. and Delestrade, C. *C.R. Acad. Sci., Paris*, **228**, 415–17 (*Jan.* 31, 1949) *In French.*—The results of extensive photoelectric measures of the zenithal night-sky brightness in blue, red and infrared light are tabulated. Variation of colour from night to night is expressed as a ratio, e.g. blue/red. The ratio, total blue/total red, passes through a pronounced max. in June, 1947, interpreted as a pseudo-twilight effect. Night-to-night variations of colour and brightness are of similar magnitude, and erratic. D. R. B.

551.593.9

7482. On the infra-red radiation of the night sky. Rodionov, S. F. and Pavlova, E. N. *Dokl. Akad. Nauk, SSSR*, **65** (*No.* 6) 831–4 (1949) *In Russian.*

551.593.9

7483. Polarization and exciting mechanism of the Na *D* line in the twilight sky. Bricard, J., Kastler, A. and Robley, R. *C.R. Acad. Sci., Paris*, **228**, 1601–3 (*May* 16, 1949) *In French.*—Of the two possible modes of light emission from Na atoms in the upper atmosphere at twilight, excitation by solar u.v. radiation should result in rather diffuse, unpolarized D_1,D_2 components of the yellow doublet. Alternatively, excitation by optical resonance should give sharp components emitting weakly polarized light ($p \sim 9\%$). Recent observations at Abisko (N Lat. 68°), obtained with a modified Savart polariscope, support the latter alternative. D. R. B.

551.594

7484. A new method of measuring the vertical electric field in the atmosphere. Chalmers, J. A. *J. Sci. Instrum. Phys. Ind.*, **26**, 300–1 (*Sept.*, 1949).—The method employs a steel ball rolling off an earthed gutter which carries a charge $\propto$ the atmospheric electric field; this charge is amplified and measured by a galvanometer. A.

551.594.22

7485. Variations in the electromagnetic field due to atmospheric discharges and corresponding methods of study. Norinder, H. *Ann. Geofis.*, **2**, 167–202 (*April*, 1949) *In Italian.*—A description of the principles employed in the measurement of these variations and a summary of the types of cathode-ray tubes used. Two types of c.r.t. were constructed at the University of Uppsala; in one, the electronic beam impinges directly on the photographic film *in vacuo*; in the other, the photograph is taken outside the closed tube. Examples are given of the photographic records. A. C. C.

551.594.5

7486. Permitted lines of neutral O and N in auroral spectra. Dufay, J. *C.R. Acad. Sci., Paris*, **228**, 496–8 (*Feb.* 7, 1949) *In French.*—For the first time, permitted lines of O I and N I have been detected with certainty in the near i.r. spectrum of a low latitude auroral display photographed at Lick Observatory, U.S.A., on the night of August 7–8, 1948. D. R. B.

551.594.5

7487. A recording meter for auroral radiations. Penn, W. D. and Currie, B. W. *Canad. J. Res. A*, **27**, 45–52 (*May*, 1949).—Describes a device developed

to give a continuous record of the intensity of auroral radiations from the zenithal sky. Detection is by means of the multiplier phototube, RCA type 1P21. A null method of recording is used, the light flux reaching the phototube being kept to a constant value by moving a neutral wedge filter in front of the phototube. A simple servomechanism is used for this purpose. A pen attached to the filter traces a record of the changes of auroral intensity on a clock-driven chart. A.

551.594.5

7488. Vertical extent of auroral streamers in the sunlit and shadow regions of the atmosphere. STÖRMER, C. *C.R. Acad. Sci., Paris*, **228**, 1904–6 (*June* 20, 1949) *In French.*—Analyses of more than 35 000 photograms of auroral streamers from the Norwegian network of linked stations show a systematic difference in the heights of rays illuminated by sunlight when compared with those formed wholly within the shadow region. Sunlit streamers, on the average, are found at heights $\sim$ twice as great as those in the earth shadow; and their bases fall at a level intermediate to the mean height for each type. Whereas streamers observed in shadow rarely exceed heights $\sim$ 600 km, sunlit rays have been observed to heights $>$ 1 000 km. D. R. B.

551.594.6 : 621.396.11

7489. Atmospheric effects on short-wave radio propagation. MCPETRIE, J. S. AND STARKEY, B. J. Letter in *Nature, Lond.*, **163**, 958–9 (*June* 18, 1949).—Measurements made on 9 cm for a 60-mile oversea path show that when either or both transmitting and receiving aerials are well above the top of a low-level atmospheric duct [up to 100 ft above the sea] such ducts have little effect on transmission. Measurements on a wavelength of 3·5 m over the same path show that at this wavelength, even for low paths, the effect of low-level ducts is unimportant. [See also Abstr. 2256 (1949)]. W. J. G. B. (R)

551.594.6 : 621.396.11

7490. Ionospheric research. MCNISH, A. G. *Adv. Electronics*, **1**, 317–46 (1948).—A review of work of the last 10 years, main attention being devoted to the influence of ionospheric effects on radiocommunication. Main sections: distribution of layers and geomagnetic effects; method of calculating maximum usable frequencies; effects of solar activity; prediction of disturbances; sporadic *E* reflections; absorption of radio waves; radio noise; meteor trail reflections; high-speed multifrequency recorder; trends of research. Bibliography of 49 selected refs. published since 1938.

BIOLOGY 57/59

575

7491. The physical basis of life. BERNAL, J. D. *Proc. Phys. Soc., Lond. A*, **62**, 537–58 (*Sept.*, 1949); also *B*, **62**, 597–618 (*Oct.*, 1949).

578.088.5 : 541.141

Relationships between chemical and biological effects of ionizing radiations. *See Abstr.* 7364

MEDICAL SCIENCE . HUMAN PHYSIOLOGY 61

612.537.74 : 621.317.39

7492. The use of a change in capacity to record cardiac volume in human subjects. WHITEHORN, W. V. AND PERL, E. R. *Science*, **109**, 262–3 (*March* 11, 1949).—A capacitor consisting of two Al discs 15 cm in dia. is placed before and behind thorax so as to include the cardiac region in their field. At 10·7 Mc/s the permittivity of blood was $\sim$ 1·75 compared with 1·0 for air. Varying amounts of blood in the field during phases of cardiac cycle cause measurable changes in capacitance. The capacitor is used as a portion of the frequency-determining circuit of an oscillator. A f.m. discriminator is used to convert the changes in frequency to a measurable form, and after amplification the record is obtained on a string galvanometer. T. A. C. (R)

612.85 : 534.7

7493. Theory of the mechanics of the cochlea. ZWISLOCKI-MÓSCICKI, J. *Diss. Eidg. Tech. Hochschule (Zürich*, 1948) [*Buchdruckerei Gassmann A.G., Solothurn*] 76 *pp. In German.*—The general conditions for the propagation of vibrations in the cochlea of the ear are described on the basis of anatomical data. The ductus cochlearis possesses both mass and damping, and its elasticity is subject to local variations. A differential equation is deduced having terms covering the density of the perilymph and its viscosity, the dimensions of the canal, and the impedance of the ductus cochlearis. The equation is independent of the shape of the canal and the course of the vibrations with respect to time. The solution of the equation agrees with the known experimental data, and shows that the amplitude and wavelength of the vibrations propagated in the cochlea change without discontinuity. A single local vibration maximum is produced requiring neither wave reflection nor resonance in the ductus cochlearis, the maximum occurring where the impedance of the ductus cochlearis possesses an elastic character. Because of the damping, the maximum does not arise at the point of resonance. The mass of the ductus cochlearis may be neglected, and hence a nearly exact solution of the differential equation may be obtained. A. C. W.

614.485 : 628.903

7494. Hygienic assessment and problems of standardization of luminescent lighting. NEUSTADT, YA. E. *Izv. Akad. Nauk, SSSR, Ser. Fiz.*, **13** (*No.* 2) 302–7 (1949) *In Russian.*

614.8 : 539.166

Concrete as a protective barrier for gamma rays from radium. *See Abstr.* 7254

615.849 : 621.389.029.6

7495. The electromedical significance of decimetre and centimetre waves. REUSSE, W. *Elektrotechnik, Berlin*, **3**, 3–9 (*Jan.*, 1949) *In German.*—A review of the factors affecting heat distribution in body tissues for condenser, induction and radiation fields is given, and it is shown that dm-waves have the advantage of reduced heating in fatty tissue as well as easier matching at skin. Penetration depth is of the order of 2·5 cm for 25 cm wavelength, thus limiting the volume treated. Dielectric focusing cones and multiple beam irradiation techniques are discussed briefly. F. T. F. (R

PHOTOGRAPHY 77

771.31 : 533.59

7496. A high-vacuum camera. GRIFFITHS, L. J. *J. Sci. Instrum. Phys. Ind.*, **26**, 306–8 (*Sept.*, 1949).—A camera for use in a demountable, continuously evacuated cathode-ray oscillograph is described. It incorporates an air-lock system so that the photographic plate can be replaced without letting down the main vacuum. The volume of air to be pumped out after each change is only of the order of $\frac{1}{4}$ l and the whole operation is accomplished by the rotation of a single ground joint. The camera may be used equally well in an electron microscope or in an electron diffraction apparatus. A.

771.31 : 550.822

Deep-well camera. *See Abstr.* 7453

778.3

7497. On the theory of the Sabattier effect. ARENS, H. *Z. Wiss. Photogr.*, **44** (*Nos* 1–7) 44–50 (1949) *In German.*—A survey is given of the history, theories and practical applications of the Sabattier effect. The theories are divided into the printing effect, the stoppage of development of negative image caused by exposure during development and the desensitization effects. R. H. H.

778.3

7498. On the theory of the Sabattier effect. II. A new theory of the Sabattier effect. ARENS, H. *Z. wiss. Photogr.*, **44** (*Nos* 1–7) 51–7 (1949) *In German.*—An explanation of the Sabattier effect is given which is based on recent theories of the latent image distribution. The formation of internal images by normal exposure leads to partial reversal by subsequent exposure during development when latent images in all grains are formed. The presence of the internal images prevents the formation of surface images in these special grains which become thus desensitized. A similarity between the reversal effects occurring in the Clayden and Albert effect and that of the Sabattier effect is indicated. R. H. H.

778.3

7499. Sensitivity of quantitative autoradiography. ZUBER, K. *Helv. Phys. Acta*, **22** (*No.* 2) 112–18 (1949) *In German.*—Continuing an earlier paper [Abstr. 4378 (1949)] the author shows that photographic films are preferable to counter tubes in certain cases for the obtaining of quantitative results. An accuracy of 20% is worked to throughout. For substances with a $\frac{1}{2}$-life sufficiently long to yield at least 500 β-particles per mm^2 of film from a reasonably small amount of active material, the method is satisfactory provided the limit of the β-spectrum is about 1 MeV. For weaker β-rays, such as from C^{14}, the number required is about 5 times greater. G. O. B.

778.37 : 621.327.4

7500. Gas-filled discharge tubes as light sources for high speed photography. MITCHELL, J. W. *Trans. Illum. Engng Soc., Lond.*, **14** (*No.* 4) 91–104 (1949).—Describes the development of high-intensity flash discharge tubes capable of giving light flashes with an effective photographic duration of $< 1 \cdot 5$ μsec, which can be used for photographing high-velocity shells by reflected light. The properties and the limitations of flash discharge tubes in single flash and in multiple flash applications are discussed. A

LIST OF JOURNALS

The following list supplements those published with the Index Number of Vol. 51 (1948) and subsequent Numbers. Journals marked * are not received regularly though abstracts of articles from them are occasionally published. The addresses given are believed to be correct, but no responsibility can be accepted for errors.

Aero. Res. Rep. Coun. Sci. Industr. Res. Aust.	*Aeronautical Research Report. Council for Scientific and Industrial Research, Commonwealth of Australia.* 314 Albert Street, East Melbourne, C.2, Victoria.
**Gas Wld*	*Gas World.* [Abstracted by *Fuel Abstracts.*]
**Mem. Coll. Sci., Univ. Kyoto, A*	*Memoirs of the College of Science, University of Kyoto, Series A.* Kyoto.
**Rev. Electrotec., B. Aires*	*Revista Electrotecnica.* Posadas 1657–9, Buenos Aires.
Rev. Obras. Publ.	*Revista de Obras Publicas.* Alfonso XII, 3.—Escuela de Caminos, Madrid.
**Rly Gaz., Lond.*	*Railway Gazette.* 33 Tothill Street, London, S.W.1.
**Rly Mech. Engr*	*Railway Mechanical Engineer.* Simmons Boardman Publishing Co., 30 Church Street, New York 7, New York.
**Sylvania Techn.*	*Sylvania Technologist.* Technical Relations Department, Sylvania Electric Products Inc., 40–22 Lawrence Street, Flushing, New York.
Tekh. Khron.	*Tekhnika Khronika.* Technical Chamber of Greece, 4 Kolokotroni St., Athens.
**Trans. Amer. Inst. Min. Metall. Engrs*	*Transactions of the American Institute of Mining and Metallurgical Engineers.* 29 West 39th Street, New York 18, New York.
Trans. Danish Acad. Tech. Sci.	*Transactions of the Danish Academy of Technical Sciences.* Øster Voldgade 10, Copenhagen.
Trans. Roy. Inst. Techn., Stockholm	*Transactions of the Royal Institute of Technology.* Stockholm.

NEW JOURNAL

Z. angew. Math. Phys.	*Zeitschrift für angewandte Mathematik und Physik.* Verlag Birkhäuser, Elisabethenstrasse 15, Basle. First issue: January, 1950—six issues annually. Switzerland fr. 28, foreign fr. 34, single copy fr. 6.

ORIGINAL ARTICLES

It is regretted that the articles from which abstracts are made cannot be sent out on loan. Application should be made to appropriate lending libraries or to the publisher of the Journal concerned; publishers' addresses, where known, are given in the "List of Journals" published with the Index Number of Vol. 51 (1948), or in the supplementary lists published subsequently.

Abstracts signed with the following initials have been supplied through the courtesy of the organizations named, to whom enquiries concerning those abstracts should be addressed:

A.M.R.	= *Applied Mechanics Reviews*	Illinois Institute of Technology, Chicago 16, Illinois.
B.A.	= *British Abstracts*	9/10 Savile Row, London, W.1.
B.I.I.R.	= *Bulletin of the International Institute of Refrigeration*	Institut International du Froid, 9 Avenue Carnot, Paris 17e.
B.R.C.B.	= *The British Rheologists' Club Bulletin*	Lyndhurst, Links Way, Little Bookham, Leatherhead, Surrey.
E.R.A.	= British Electrical and Allied Industries Research Association	Thorncroft Manor, Dorking Road, Leatherhead, Surrey.
F.A.	= *Fuel Abstracts*	Fuel Research Station, East Greenwich, London, S.E.10.
I.A.	= *Index Aeronauticus*	Ministry of Supply, Millbank, London, S.W.1.
M.A.	= *Metallurgical Abstracts*	Institute of Metals (Incorporated), 4 Grosvenor Gardens, London, S.W.1.
M.R.	= *Mathematical Reviews*	Brown University, Providence, Rhode Island.
M.-V.	= Metropolitan-Vickers Electrical Co., Ltd.	Research Department, Trafford Park, Manchester.

P.A.	= *Photographic Abstracts*	16 Princes Gate, London, S.W.7.
P.O.	= Post Office Engineering Department	Dollis Hill, London, N.W.2.
R.E.A.	= *Railway Engineering Abstracts*	The Institution of Civil Engineers, Great George Street, London, S.W.1.
R.R.A.	= The Research Association of British Rubber Manufacturers	Intelligence Division. Summary of Current Literature, 105–7 Lansdowne Road, Croydon, Surrey.
S.C.A.P.	= Supreme Commander for the Allied Powers	Scientific and Technical Division of the Economic and Scientific Section, S.C.A.P., APO 500, c/o Postmaster, San Francisco, California.

Where the abstract has been prepared from the summary published with the article, the initial "A" is used. If no indication of language is given in the abstract, the article may generally be assumed to be in English. This does not necessarily hold, however, for abstracts reprinted from elsewhere.

ERRATA, 1949

Abstr. 444, line 1: *for* Groenewald, H. J., *read* Groenewold, H. J.

Abstr. 1384, line 3: *for* Vodar, M. B., *read* Vodar, B.

Abstr. 1688, line 1: *for* Groenewald, H. J., *read* Groenewold, H. J.

Abstr. 2936, line 4: *for* Jan. *read* Oct.

Abstr. 3485, line 2: *for* Backus, C., *read* Backus, R. C.

Abstr. 4683, line 2: *for* Narayan, P. S., *read* Narayanan, P. S.

Abstr. 4684, line 2: *for* Narayan, P. S., *read* Narayanan, P. S.

Abstr. 5270, line 2: *for* **107** *read* **167.**

Abstr. 5782, lines 5 and 6: *remove sentence in brackets.*

NOTE ON THE ARRANGEMENT OF ABSTRACTS

The Abstracts are classified by subject according to the Universal Decimal Classification, and arranged in order of their U.D.C. numbers, which are printed at the head of the Abstract on the right. Abstracts on any particular subject can be located by first consulting the abridged tables of the U.D.C. published with the January number, and then referring to the appropriate U.D.C. number in the text. The main headings are listed on p. ii of the Cover.

SYMBOLS USED IN THE U.D.C.

: links numbers denoting subjects dealt with in relation to each other in the article

\+ links numbers denoting subjects dealt with independently in the article

/ indicates extension over several numbers (e.g. 535.41/.43 represents 535.41 to 535.43 inclusive)

( ) signifies Place (e.g. (485), in Sweden)

– is used to attach special analytical subdivisions applicable to certain sections (e.g. –31, ultra-violet; hence 535.34–31, ultra-violet absorption)

.0 indicates other analytical subdivisions applicable throughout Sections 53/59 (e.g. .08, measurement; hence 536.63.08, measurement of specific heat)

. Numbers are normally divided into groups of three digits by stops for convenience

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